

Digitální modely terénu (6-8)

DMT v GIS Idrisi Andes

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411 Ústav geoinformačních technologií

Lesnická a dřevařská fakulta,

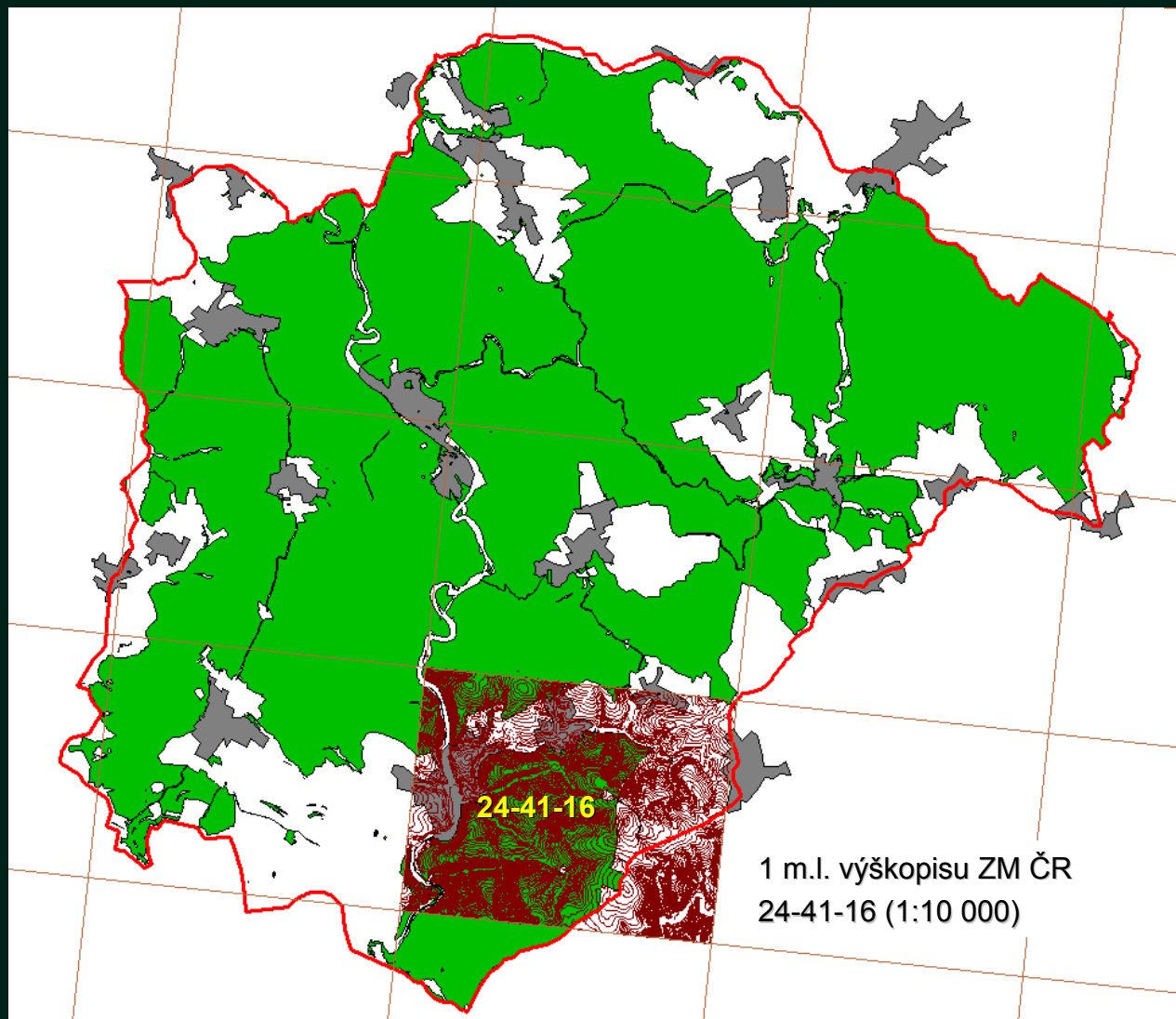
Mendelova zemědělská a lesnická univerzita v Brně



Digitální modely terénu (6)

Tvorba DMT

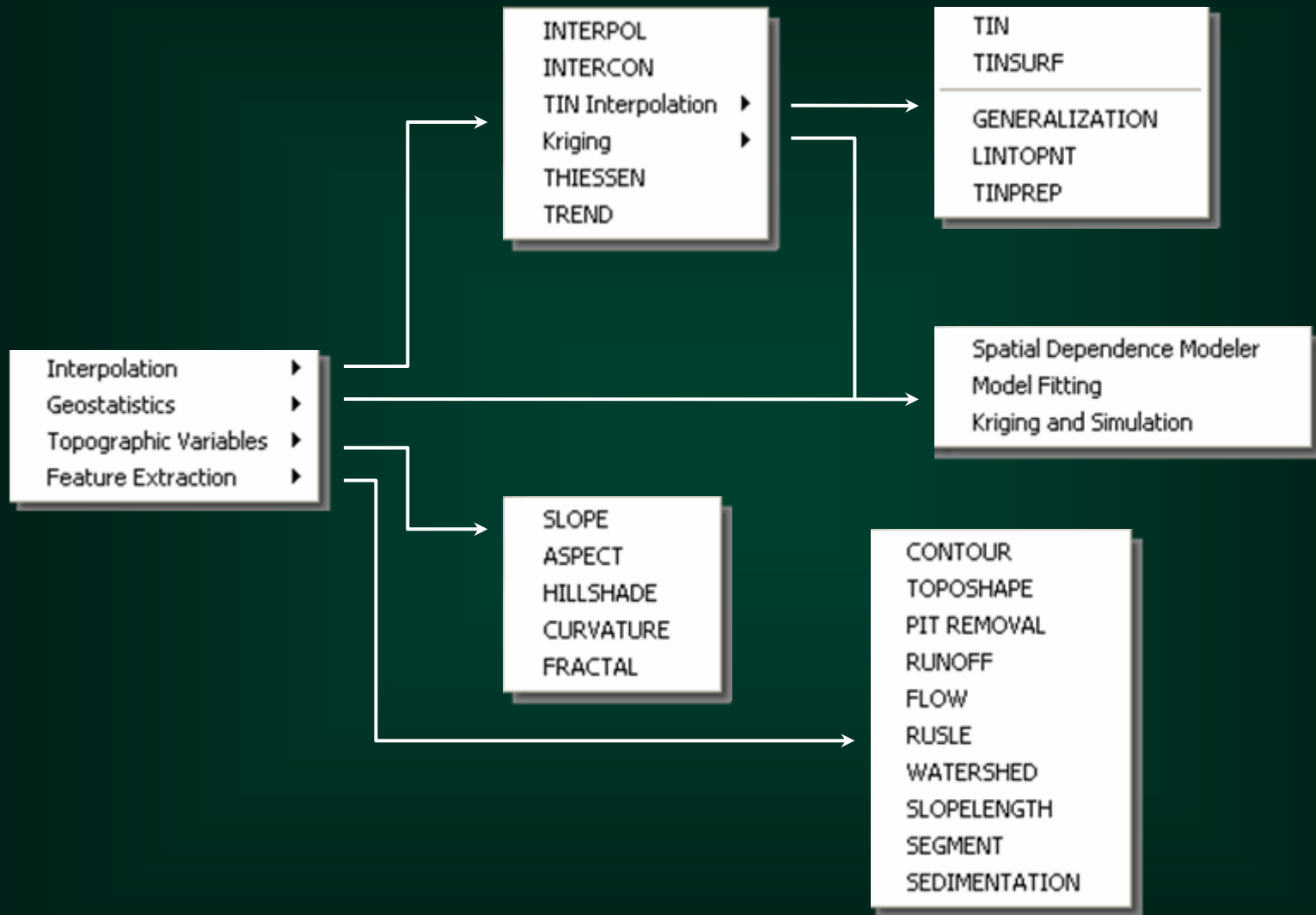
ŠLP „Masarykův les“ Křtiny



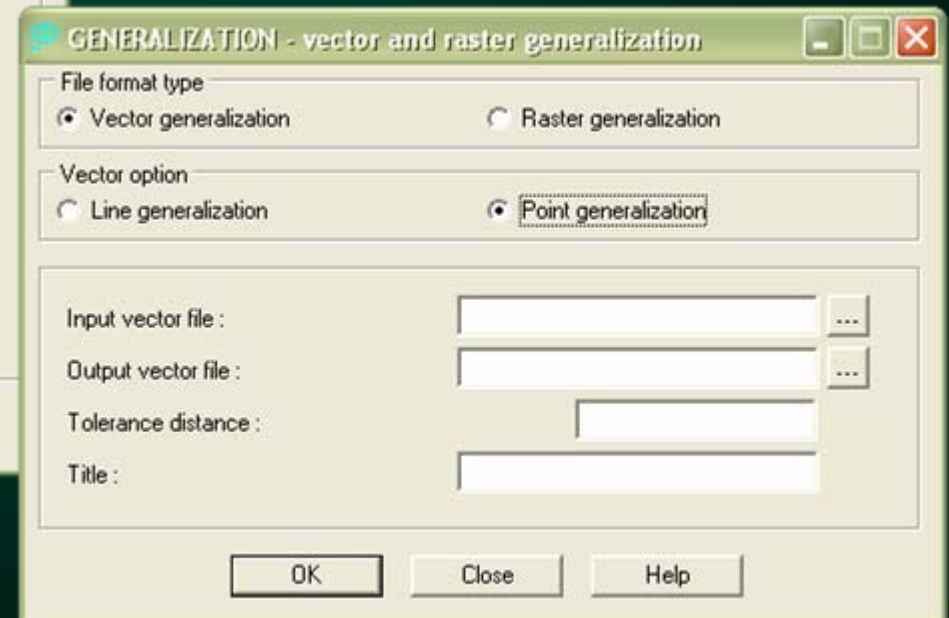
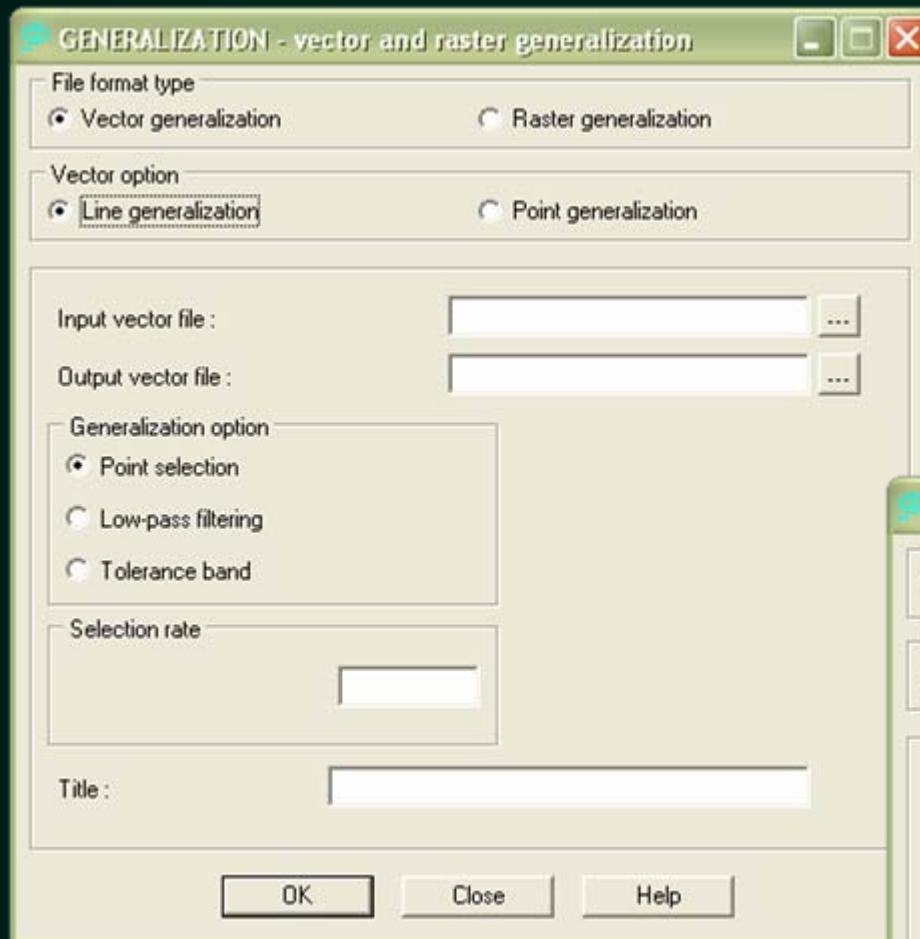
Data: S:\DMT\
(\\195.178.78.202\student\dmf\)

Import dat do Idrisi

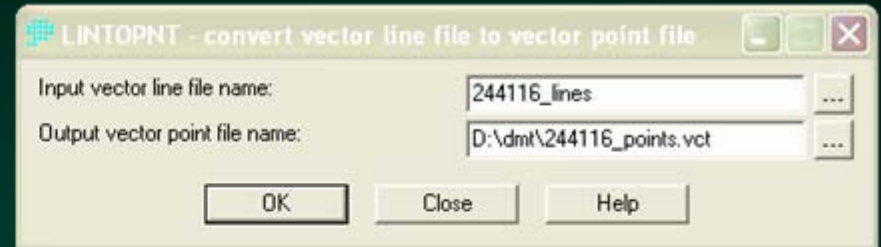
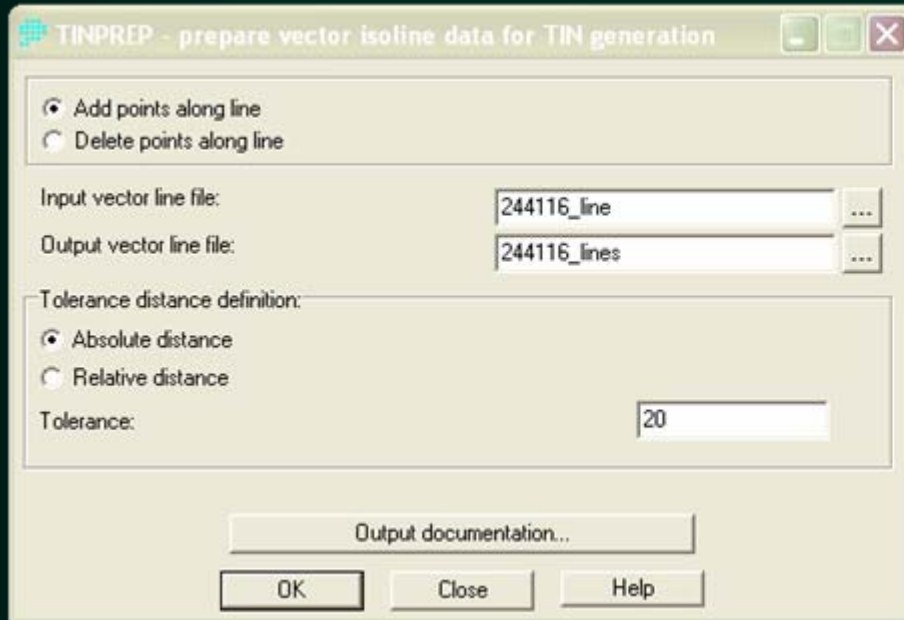
- Zkontrolovat: Start – Ovládací panely – Místní a jazykové nastavení – Desetinný oddělovač „. “ (ne „ , “)
- Spustit Idrisi Andes
- Idrisi Explorer – Projects
- Idrisi – File – Import – Software-Specific Formats – ESRI Formats – modul SHAPEIDR
- Struktura souborů (vektorové kolekce)
- Database Workshop
- Vytvořit vektorovou vrstvu z atributu výšky
- Zjistit maximální a minimální souřadnice pro výpočet velikosti pixelu (X v Idrisi = columns, Y v Idrisi = rows; ve skutečnosti je ale souřadnice X souřadnicí Y v S-JTSK a naopak)
 - Min X: -593 665.4 m, Max X: -588 438.5 m
 - Min Y: -1 157 834.6 m, Max Y: -1 153 544.8 m

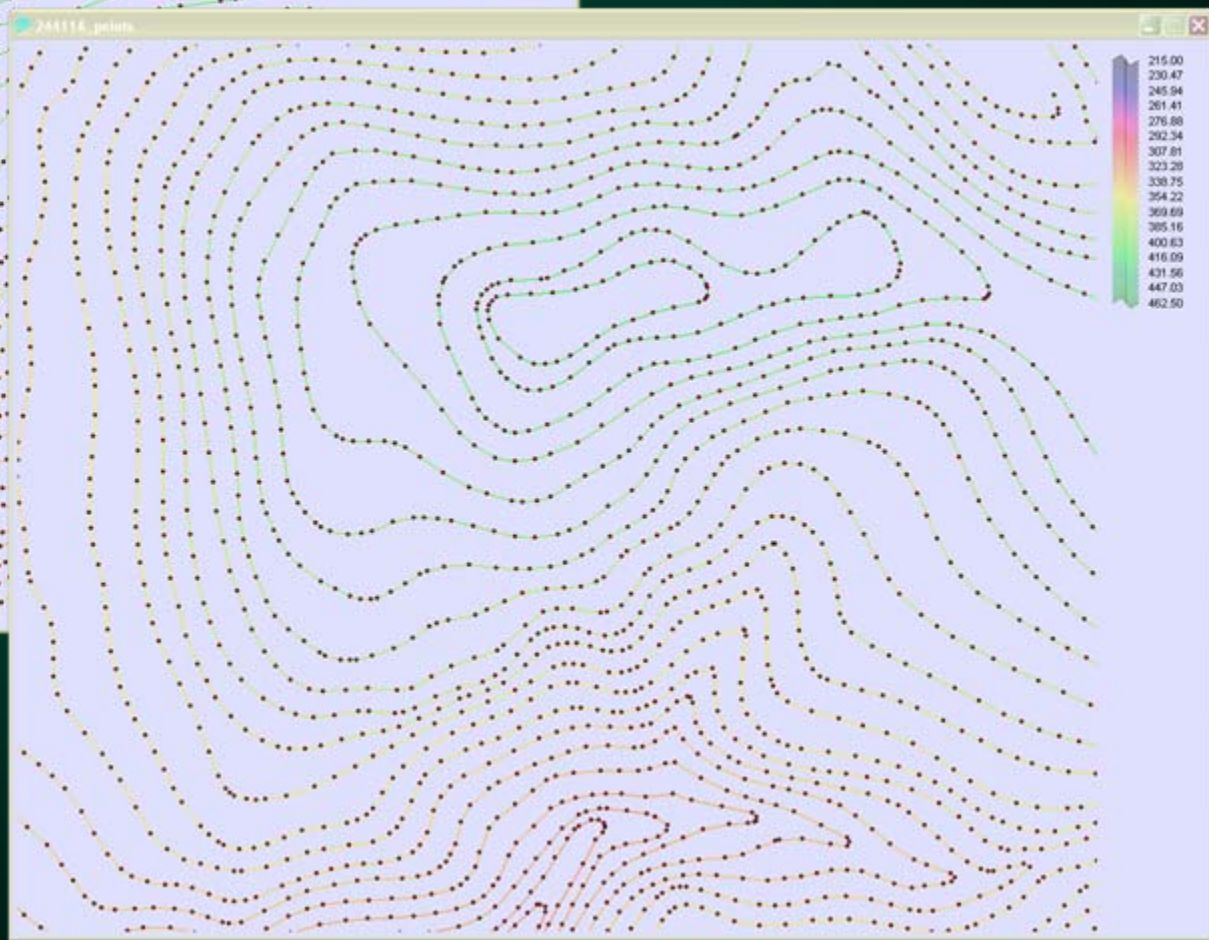


Modul GENERALIZATION



Modul TINPREP a LINTOPNT





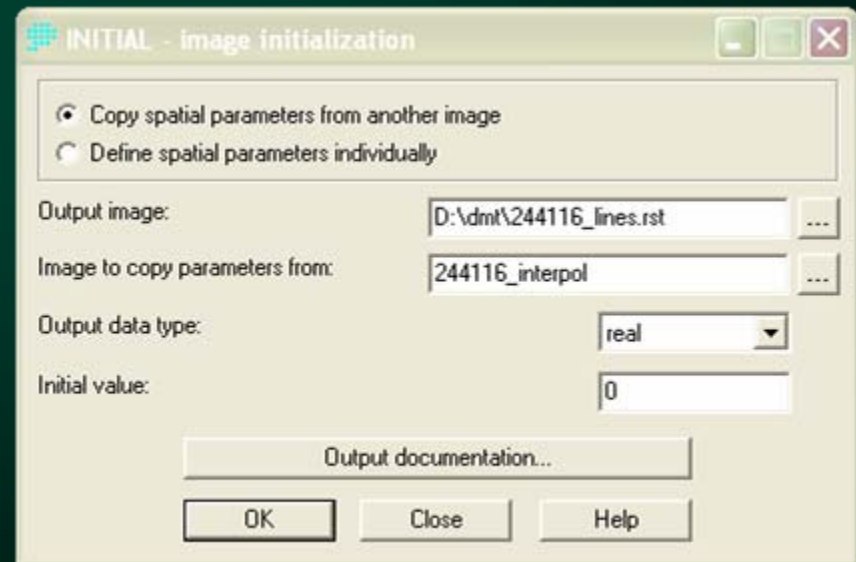
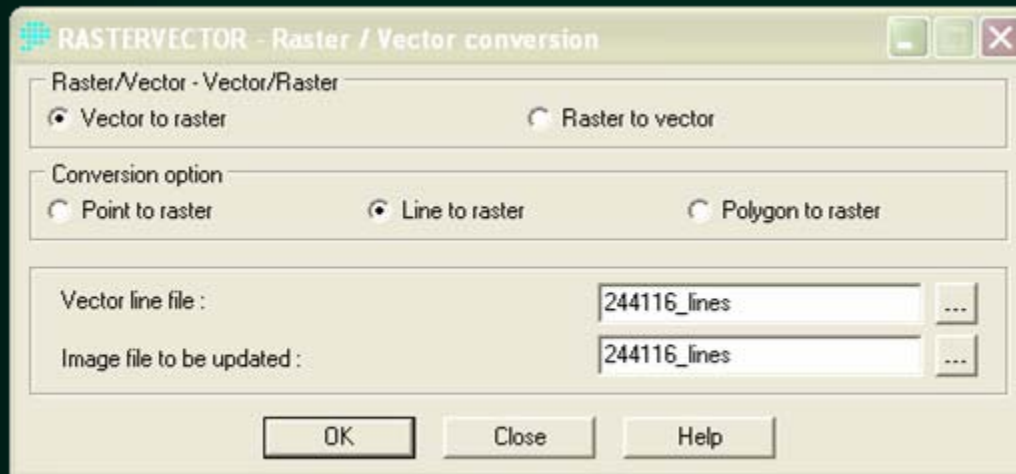
Modul INTERPOL

DMT: pixel 10 x 10 m

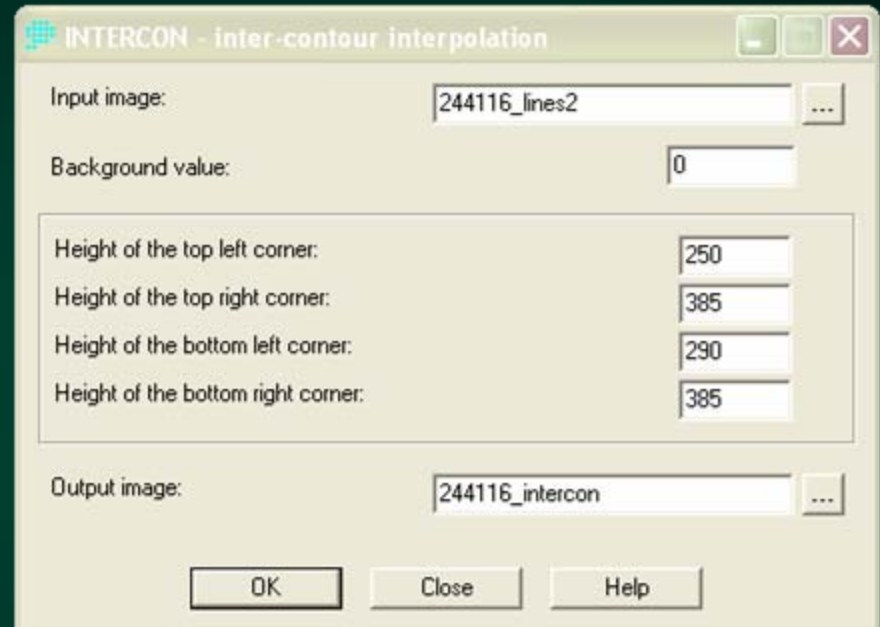
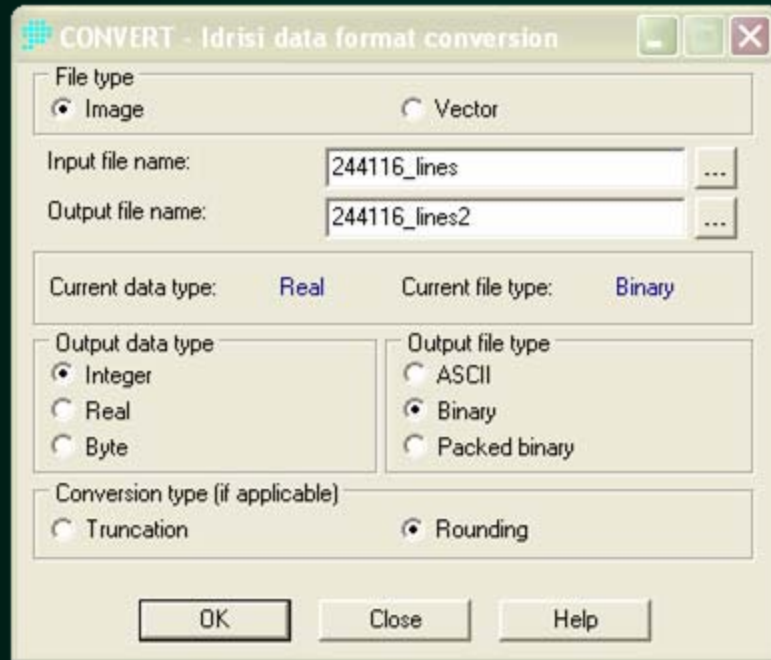
The screenshot shows the 'INTERPOL - surface interpolation' dialog box. It is divided into several sections:

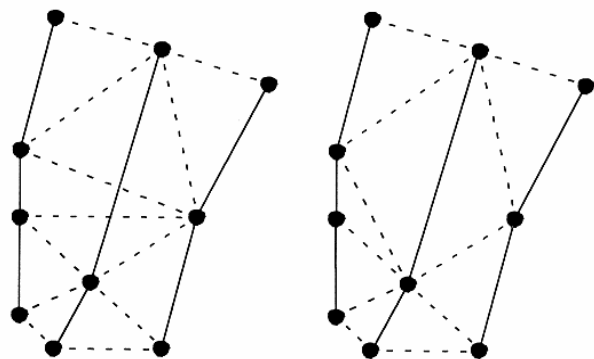
- Function:** Two radio buttons are present. The first, 'Interpolate digital elevation model', is selected. The second is 'Calculate potential surface'.
- Input vector file:** A text box contains '244116_points' with a browse button (...).
- Output image:** A text box contains '244116_interpol' with a browse button (...).
- Distance weight exponent:** A text box contains the value '2.0'.
- Data entry option:** Two radio buttons. The first, 'Use vector point ID's as heights', is selected. The second is 'Use attribute values file for heights:'.
- Use a six point search radius:** A checked checkbox.
- Output file specifications (top):** Four text boxes for coordinates: Minimum X: -593665.4375, Minimum Y: -1157834.625, Maximum X: -588438.5625, and Maximum Y: -1153544.75.
- Output file specifications (bottom):** A dropdown menu for 'Data Type' is set to 'real'. Text boxes for 'Columns' (523) and 'Rows' (429) are present. A checkbox for 'Copy from existing file:' is unchecked.
- Buttons:** 'Output documentation...', 'OK', 'Close', and 'Help'.

Modul RASTERVECTOR

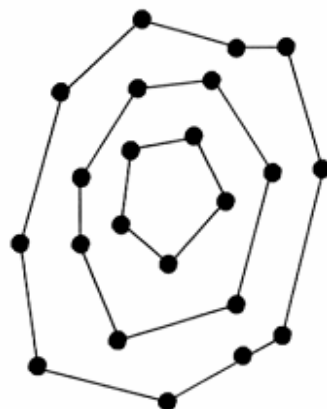


Modul INTERCON

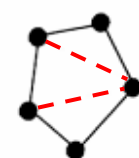




Unconstrained (left) and constrained (right) Delaunay triangulations. Solid lines represent isolines.

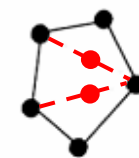


a



B/T Edges

b



Critical Points

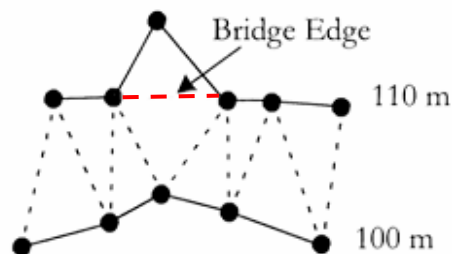
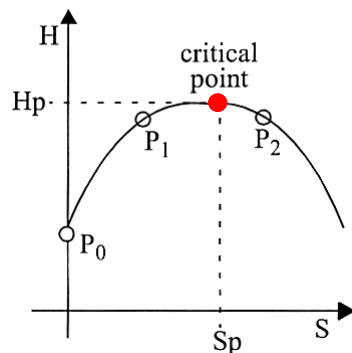
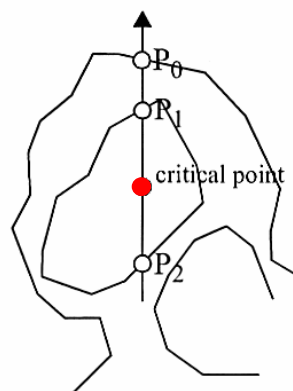
c



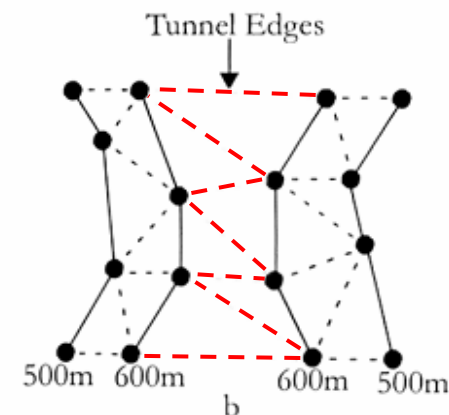
Re-Triangulation

d

a: Contours at the top of a hill; b: triangulation of highest contour, with B/T edges identified; c: placement of critical points on B/T edges;

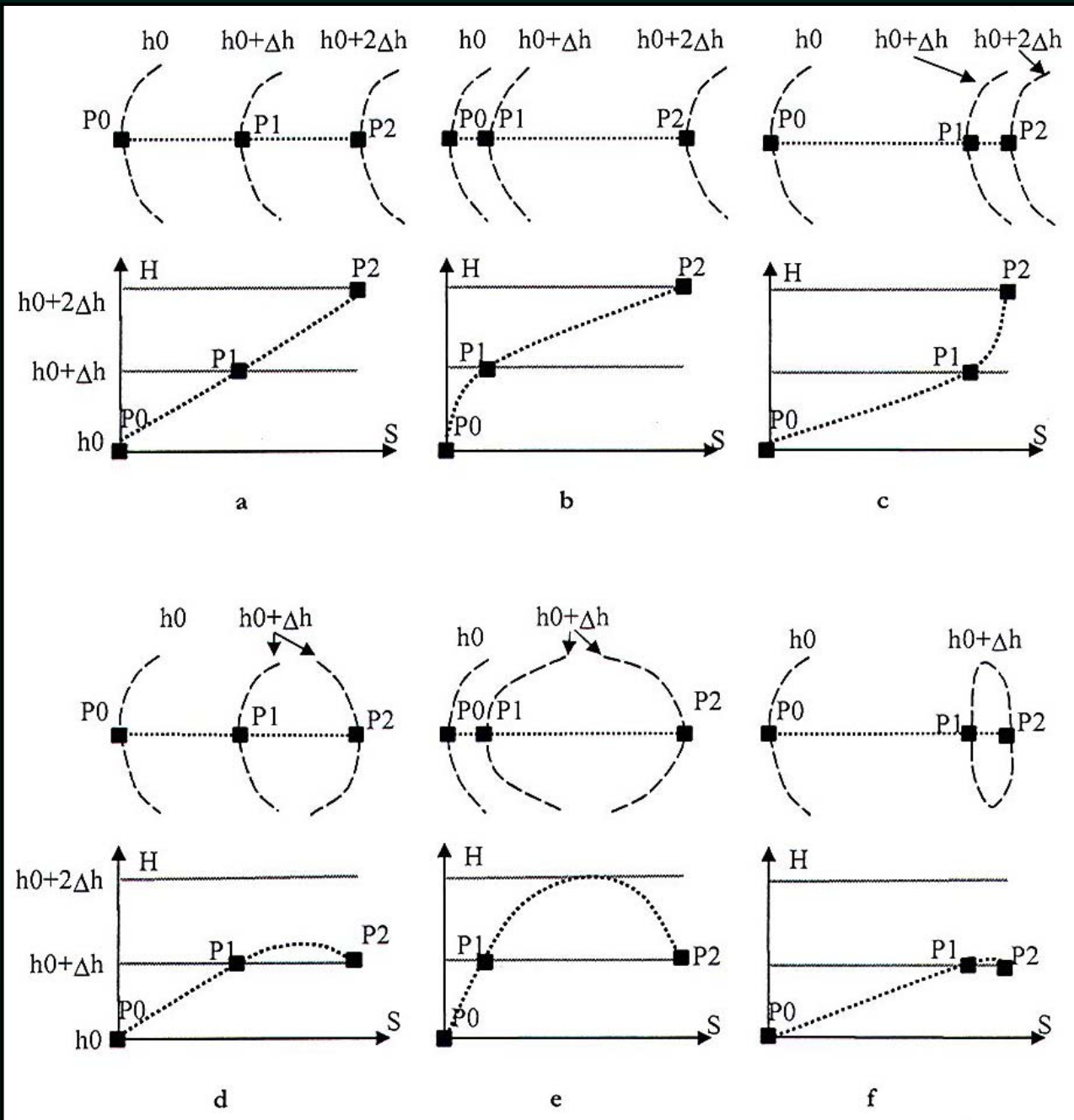


a

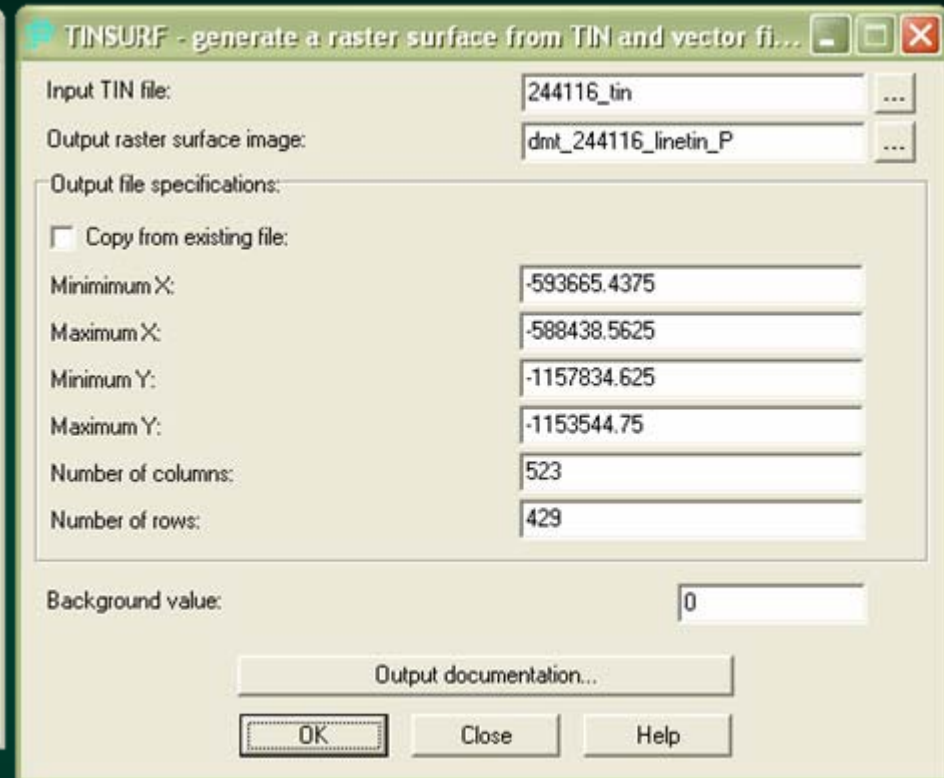
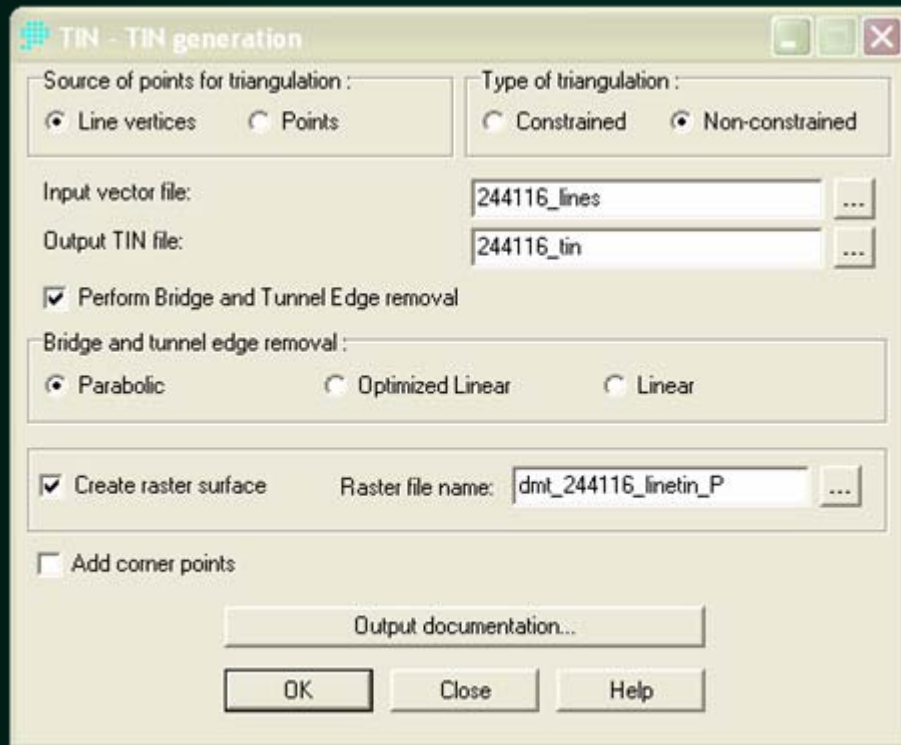


b

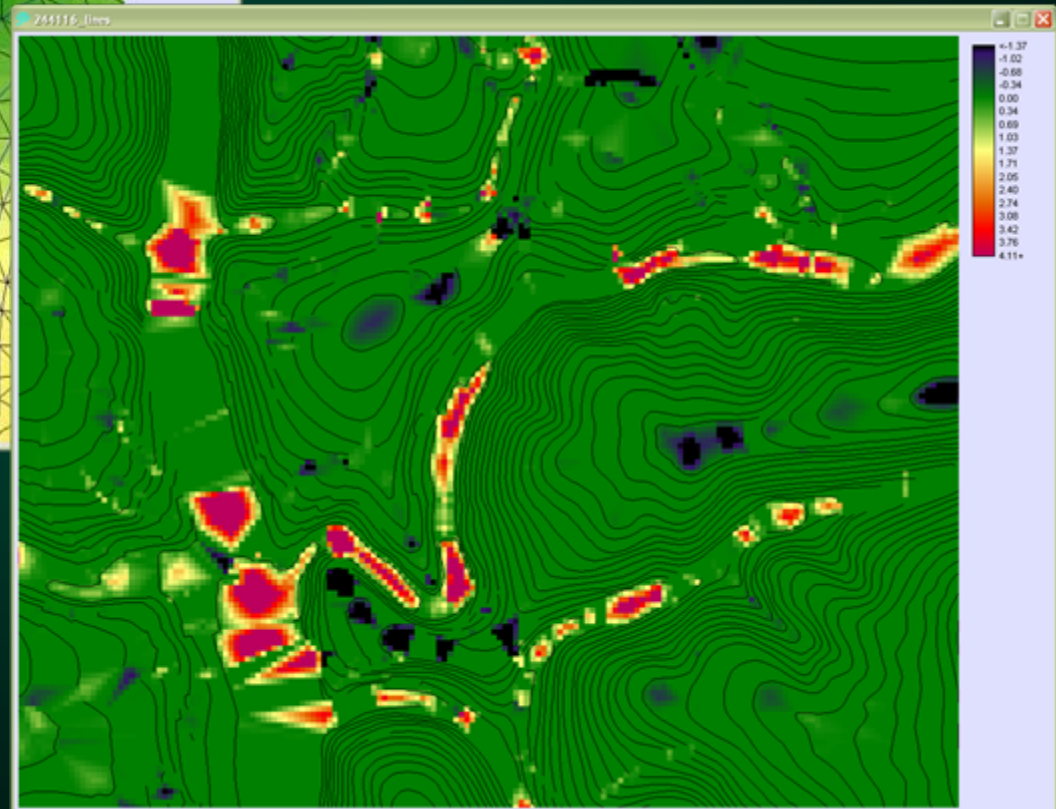
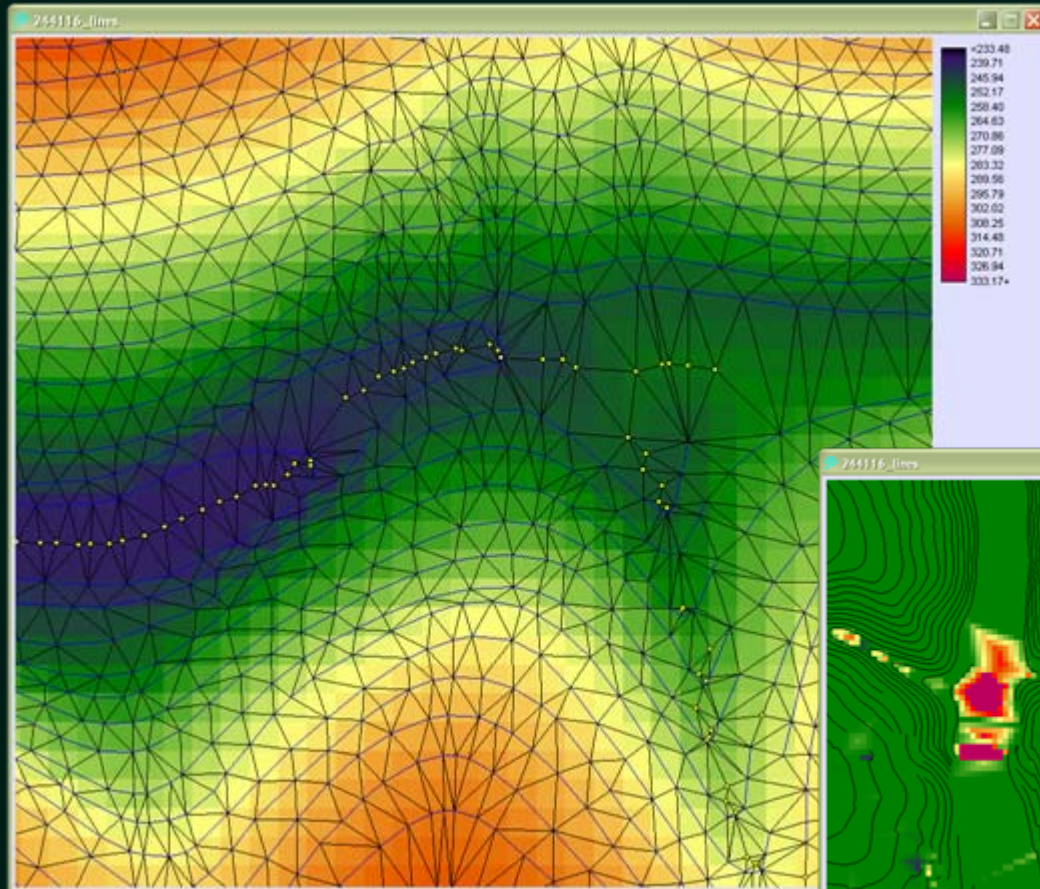
a: Contours at a stream; b: contours at a "saddle" feature. Contours are shown with solid lines, constrained triangle edges with dashed lines. B/T edges are shown in red.



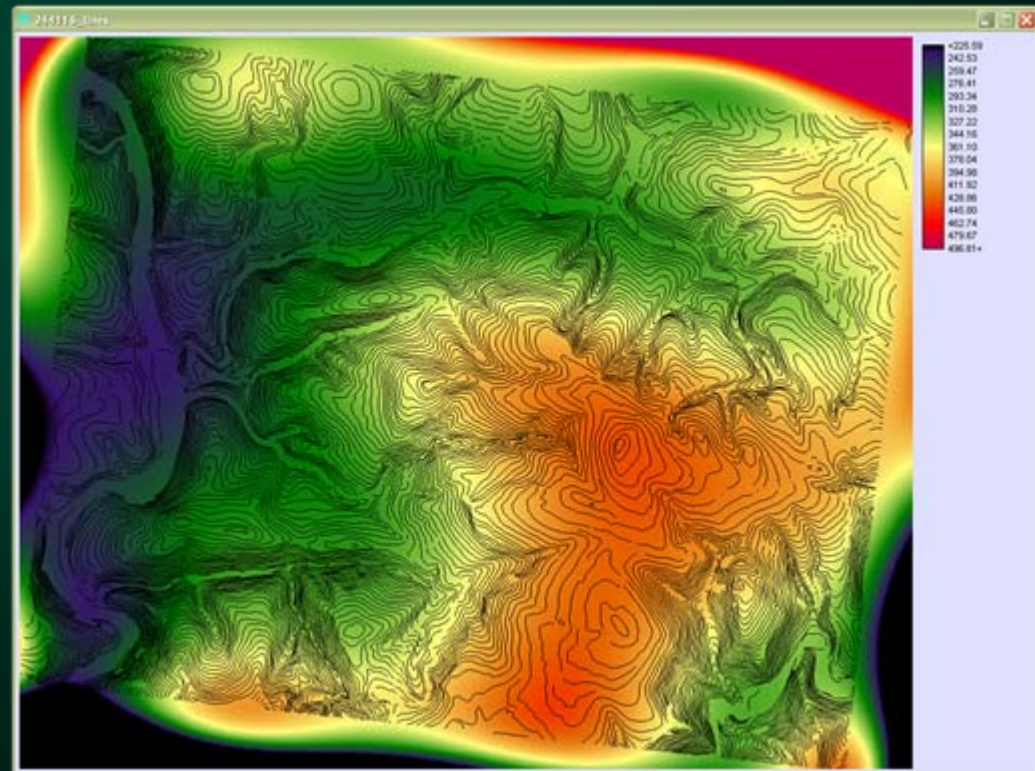
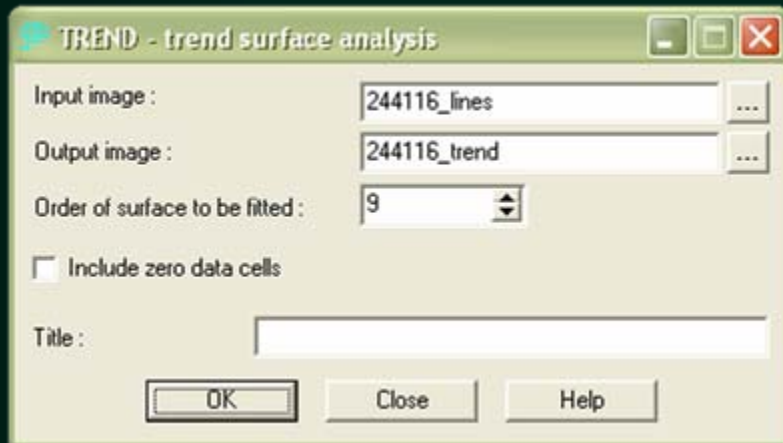
Modul TIN



- totéž provést pro jiné varianty „B/T edge removal“ a pro bodová data
- analýza rozdílů (modul OVERLAY, HISTO)

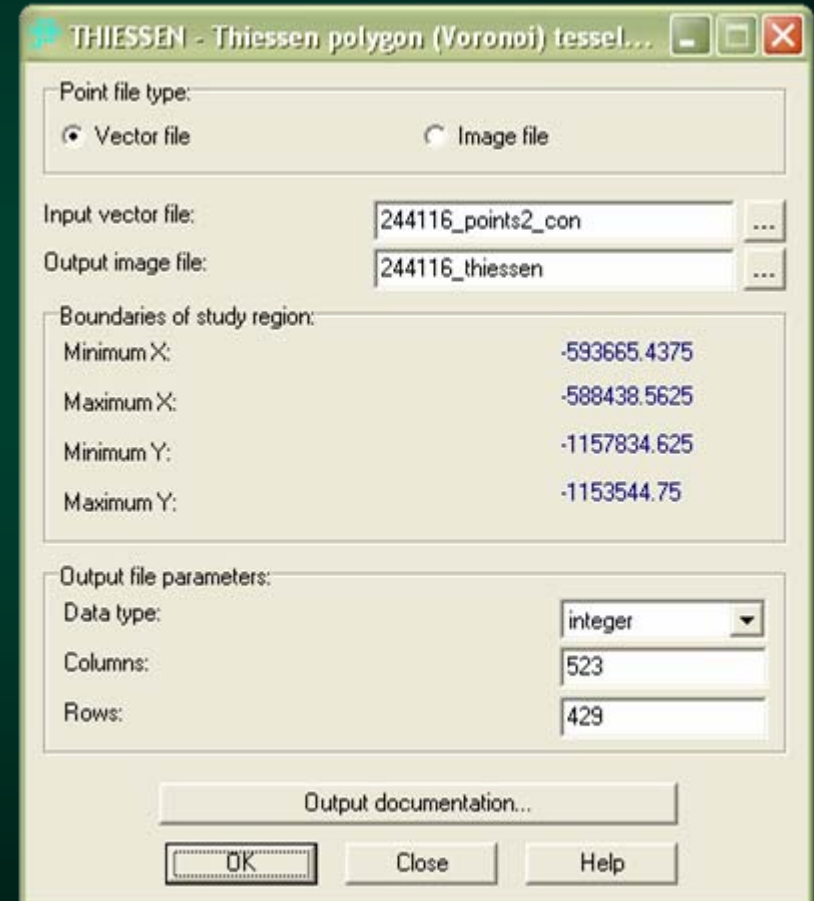
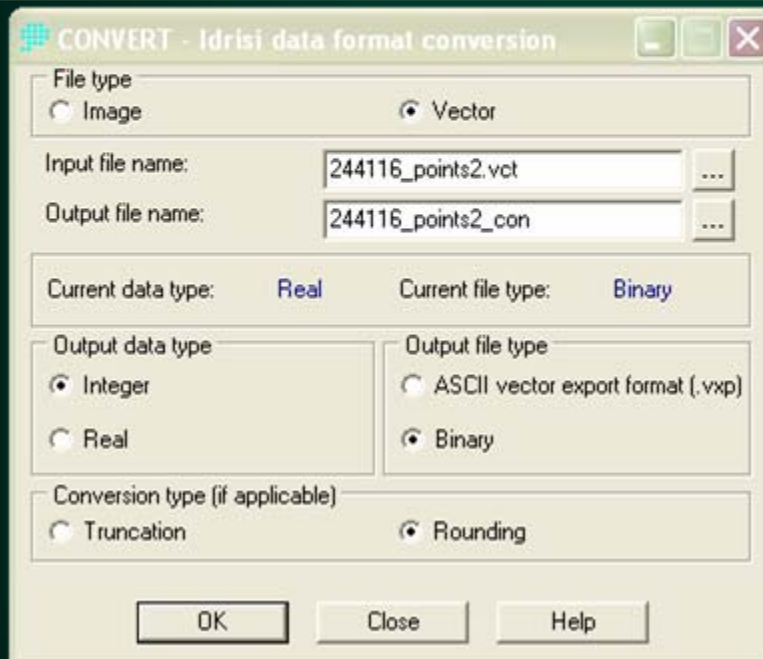
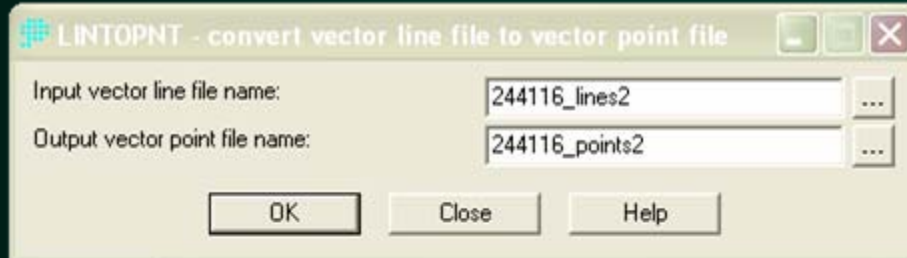


Modul TREND



Modul THIESEN

- nejprve relativně 5x redukovat počet lomových bodů vrstevnic (TINPREP)
- vyjmout lomové body (LINTOPNT) a konvertovat formát dat (CONVERT)



Digitální modely terénu (7)

Analýzy DMT

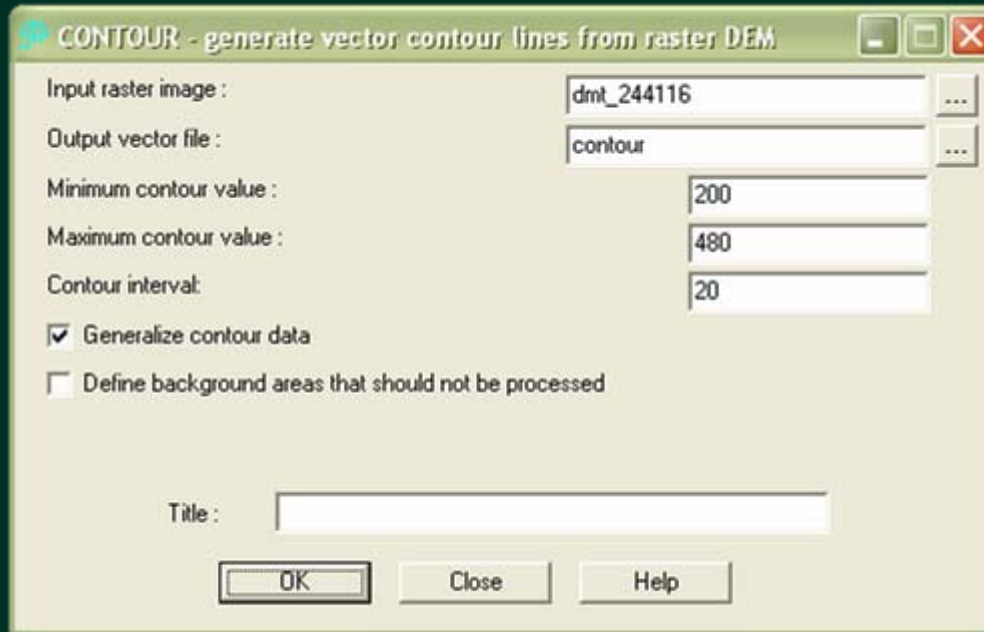
Analýzy

- modul CONTOUR - extrakce vrstevnic
- modul PROFILE - řezy terénem
- modul HILLSHADE - vytvoření stínovaného reliéfu
- modul SURFACE - výpočet sklonu a expozice svahů
- modul CURVATURE - výpočet horizontálního a vertikálního zakřivení
- modul FRACTAL - výpočet fraktálních dimenzí
- modul SEGMENT - homogenizace (segmentace) rastru DMT

- modul VIEWSHED - analýza viditelnosti
- modul WATERSHED - výpočet povodí
- modul FLOW - směry povrchového odtoku
- modul RUNOFF - akumulovaný odtok
- modul TOPOSHAPE - identifikace tvarů terénu

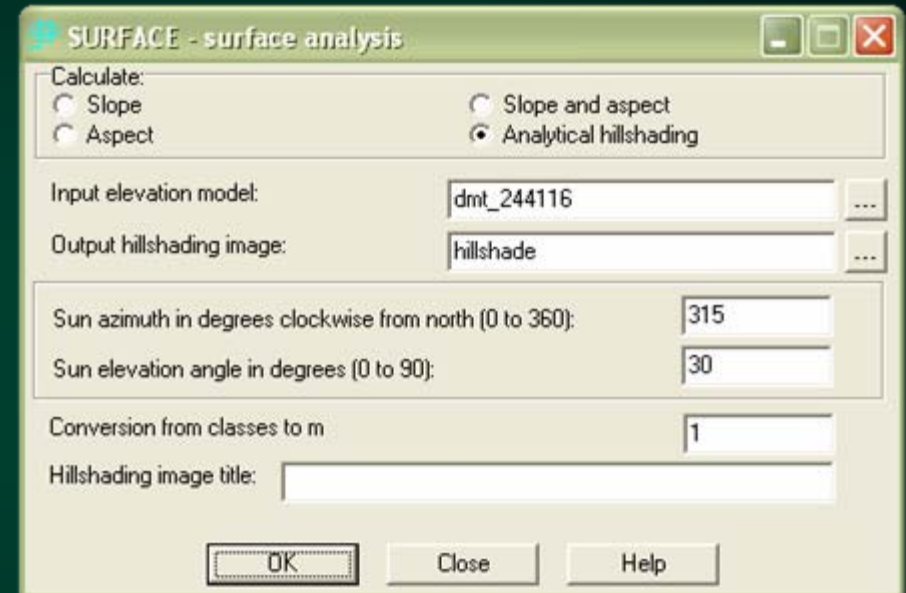
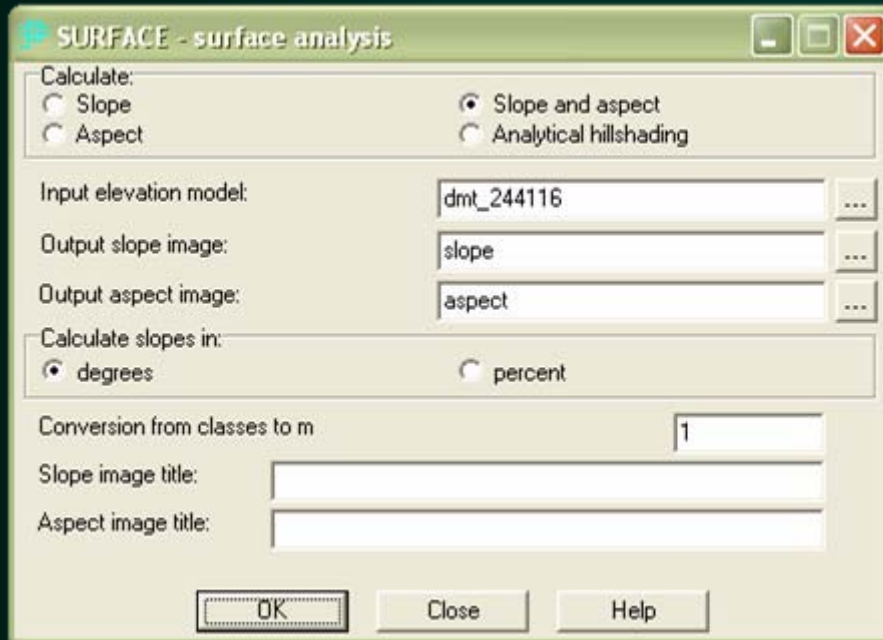
- modul RUSLE - revidovaná universální rovnice ztráty půdy, včetně možnosti samostatného výpočtu souvislé délky svahu v lokálním povodí (SLOPELENGTH) a ztráty a depozice půdy (SEDIMENTATION).

Modul CONTOUR



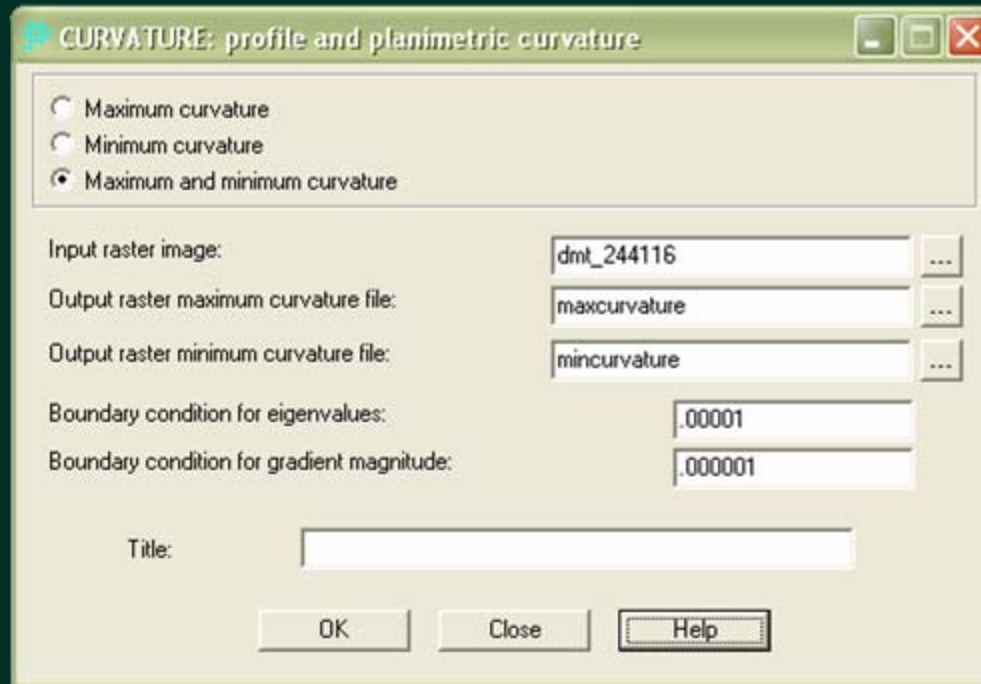
- vytvořit kompozici s DMT a původními vrstevnicemi
- vizuálně porovnat

Modul SURFACE



- modul FLY THROUGH
- modul ILLUMINATE

Modul CURVATURE

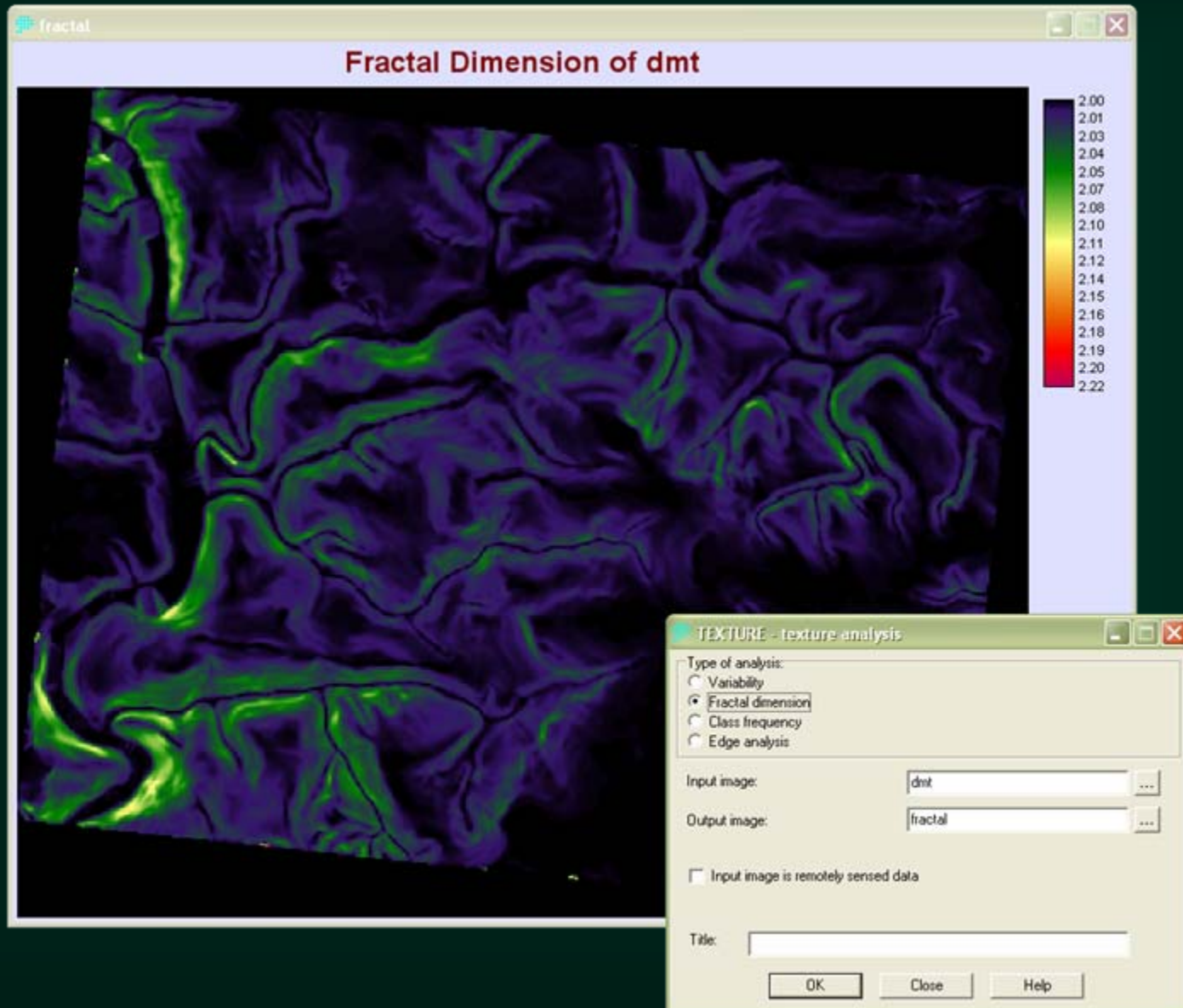


- **maximum curvature = vertikální (profilové) zakřivení**
- **minimum curvature = horizontální (planární) zakřivení**
- - konvexní tvary, + konkávní tvary

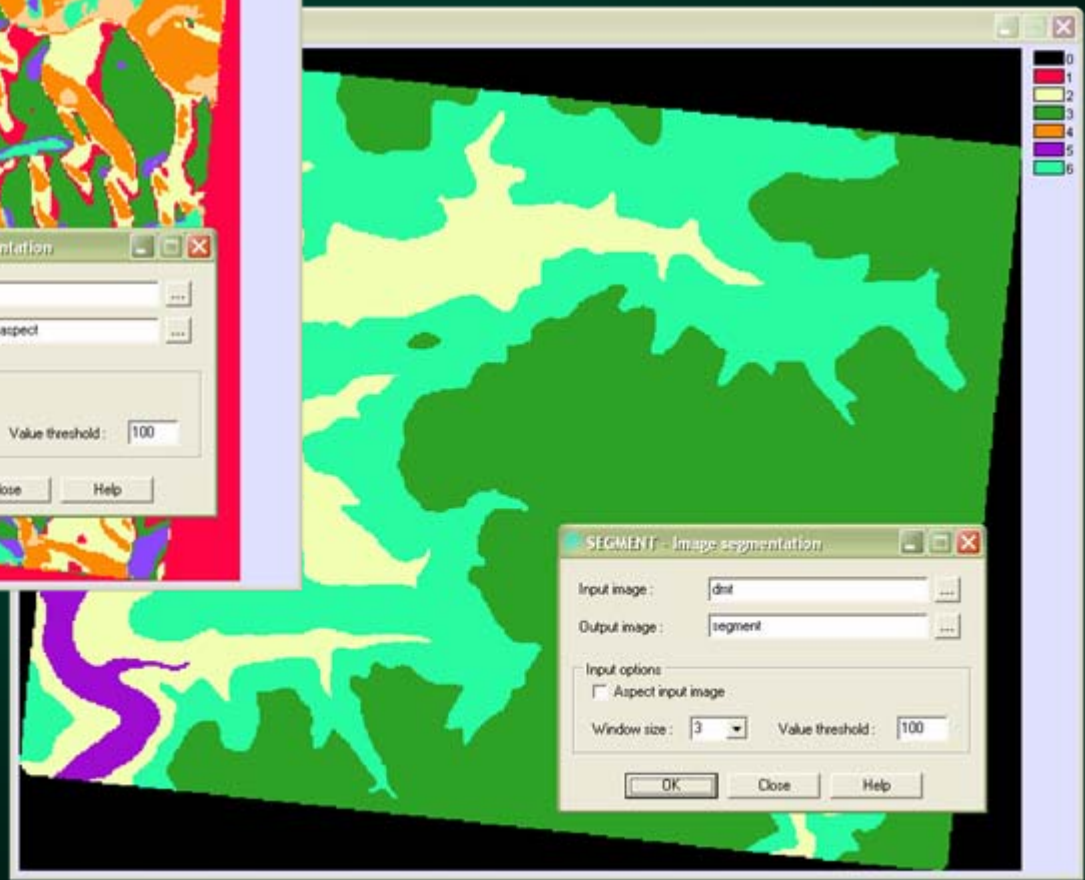
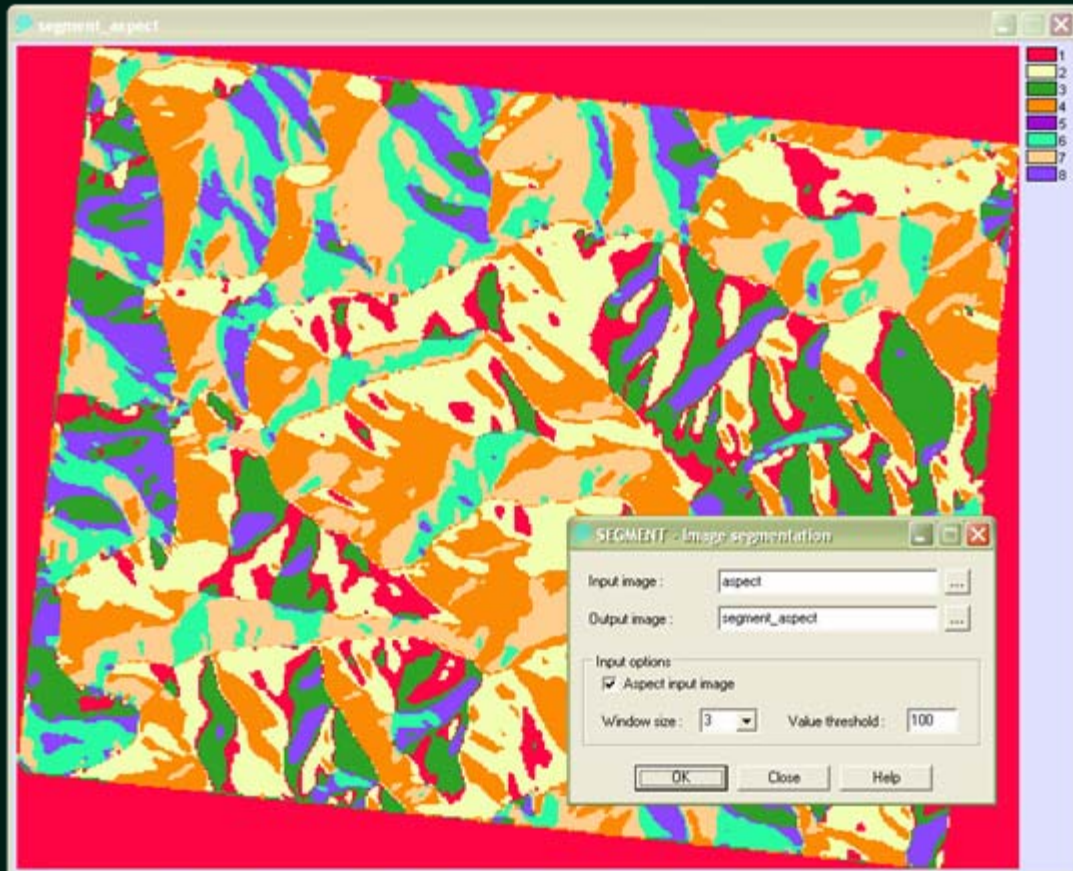
Modul PROFILE

The screenshot displays the IDRISI 15.0 'The Andes Edition' interface. The main window shows a Digital Elevation Model (DEM) titled 'DEM ZM CR 24-41-16' with a color-coded elevation scale from blue (low) to red (high). A green profile line is drawn across the map. A 'Profile' window on the right shows a line graph titled 'Profile across dmt.rst' with a y-axis ranging from 260 to 440 and an x-axis with numerical coordinates. Two dialog boxes are open: 'Digitize' and 'PROFILE - profile generator'. The 'Digitize' dialog is configured to create a 'Line' layer named 'profile' with 'Integer' data type and 'Qual' symbol. The 'PROFILE - profile generator' dialog is set to 'Over space' profile type, with the profile line saved as 'profile' and the image to be profiled as 'dmt'.

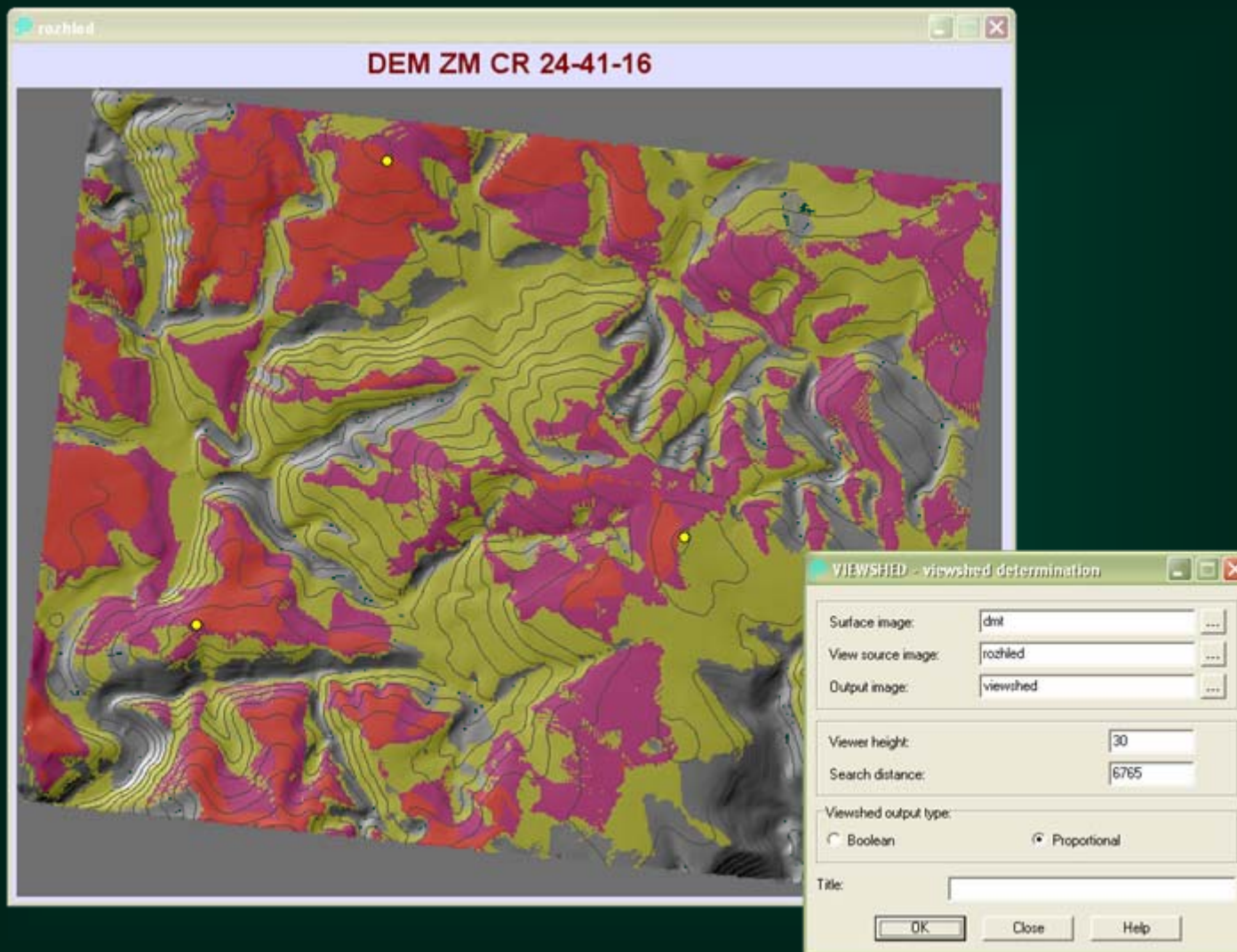
Modul FRACTAL (TEXTURE)



Modul SEGMENT



Modul VIEWSHED



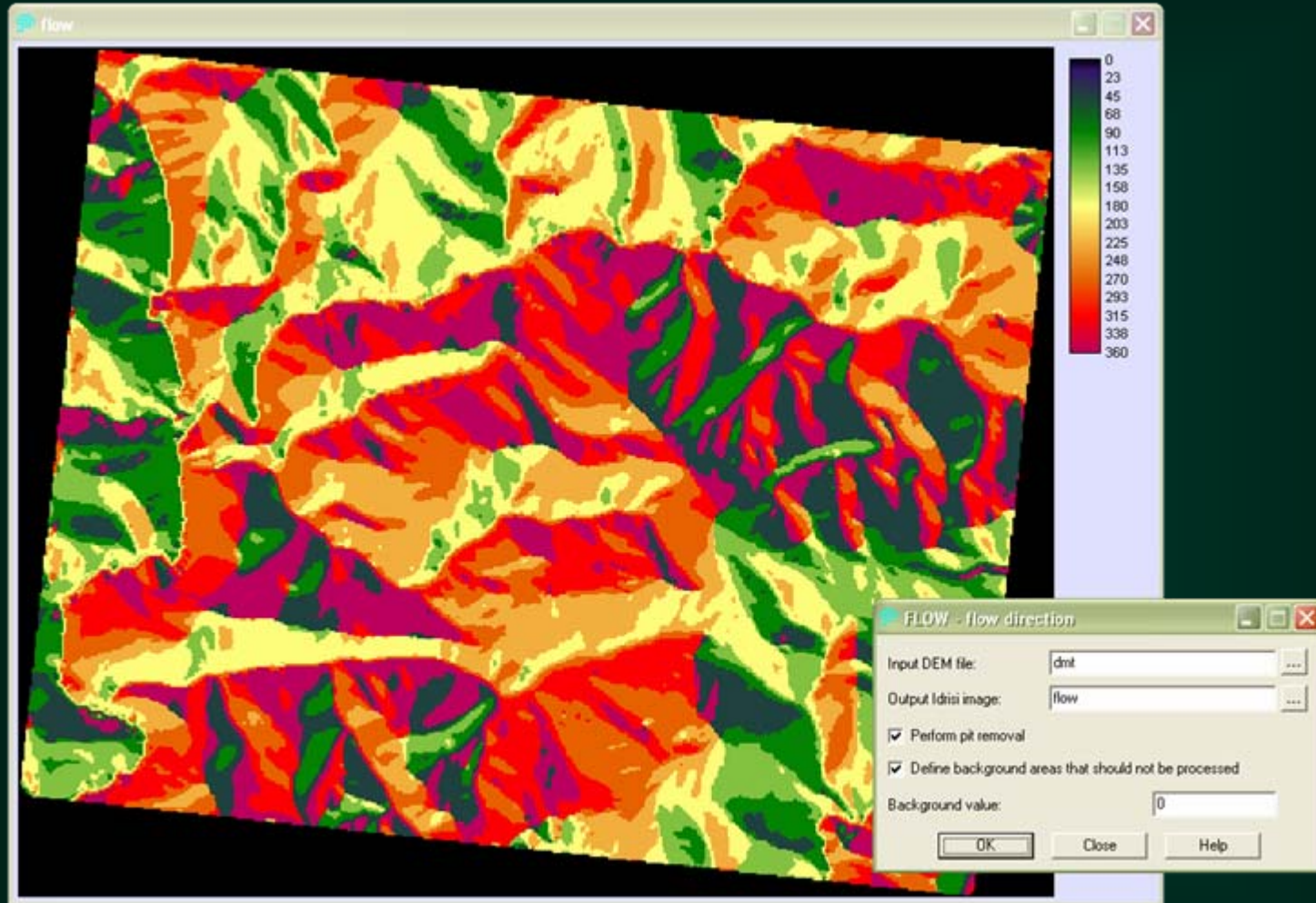
- vektorizovat (DIGITIZE) a rasterizovat body rozhledu (RASTERVECTOR)

Modul WATERSHED



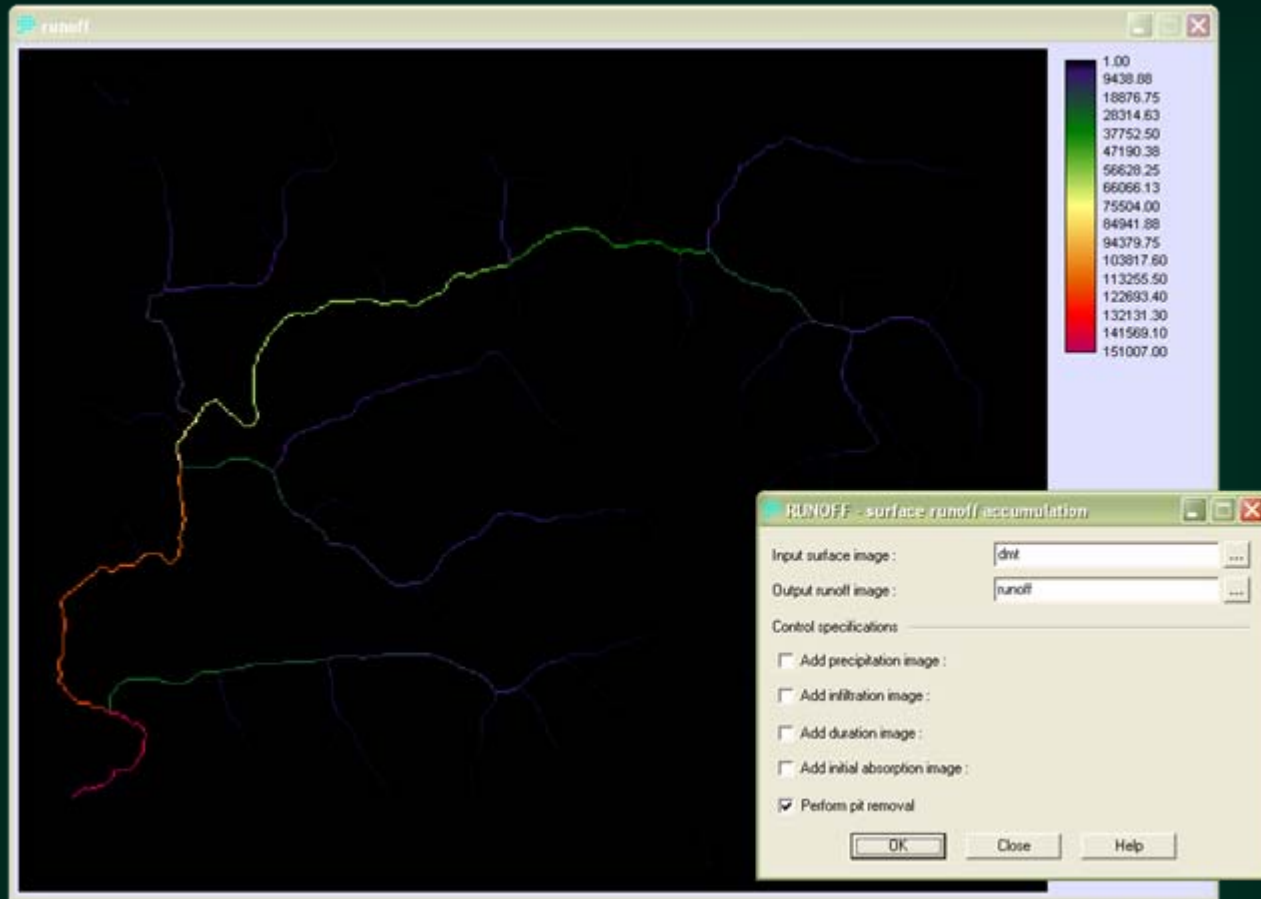
- zjistěte počet povodí pro prahovou hodnotu 5 ha
- jak byste zjistili výměru nejmenšího a největšího povodí ?
- digitalizujte vlastní uzavírací profil a zjistěte plochu jeho povodí

Modul FLOW



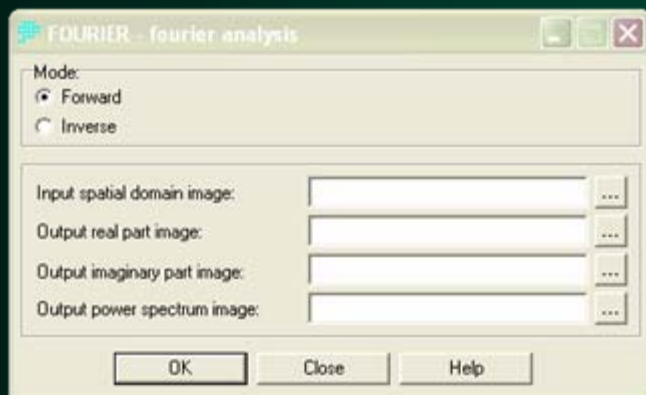
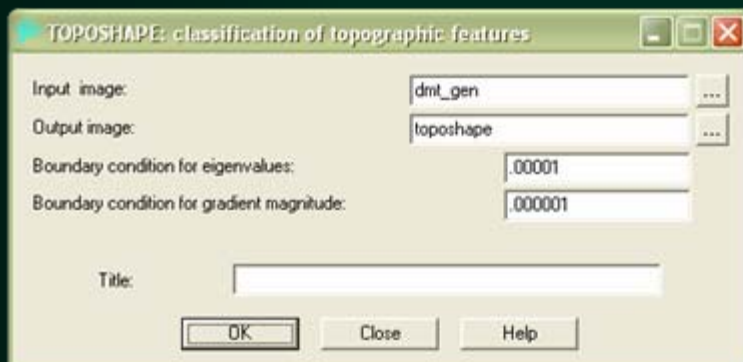
- jaký je hlavní rozdíl mezi rastrem expozič a směrů odtoku ?
- zjistěte nejčastější směr odtoku

Modul RUNOFF



- v jakých jednotkách jsou hodnoty rastru ?
- jak byste zjistili rozvodnice z rastru akumulovaného odtoku ?
- porovnejte tyto rozvodnice s povodími

Modul TOPOSHAPE



- modul FOURIER
- modul FILTER

Modul RUSLE

RUSLE - Revised universal soil loss equation

Input Files

DEM image : [] ... Precipitation image (R factor) : [] ...

Use field image : [] ... Land-cover image (C factor) : [] ...

Soil image (K factor) : [] ... Management image (P factor) : [] ...

Control Specifications

Slope threshold (%) : [] ... Aspect threshold (deg) : [] ...

Maximum slope length : [] ... Feet Smallest patch size : [] ... ft²

Rounded to shorter Rounded to longer Default background value : [0]

Average soil factor within patches

Output Files Prefix Specifications

Patch output files prefix : [] ... Field output files prefix : [] ...

Retrieve parameters Save parameters

OK Close Help

- Suk, P. *Možnosti kvantifikace erozního ohrožení půdy v GIS Idrisi*. [s.l.], 2005. 55 s. LDF MZLU v Brně
- http://mapserver.mendelu.cz/skripta/GIS_IV/CVIC05.pdf

Digitální modely terénu (8)

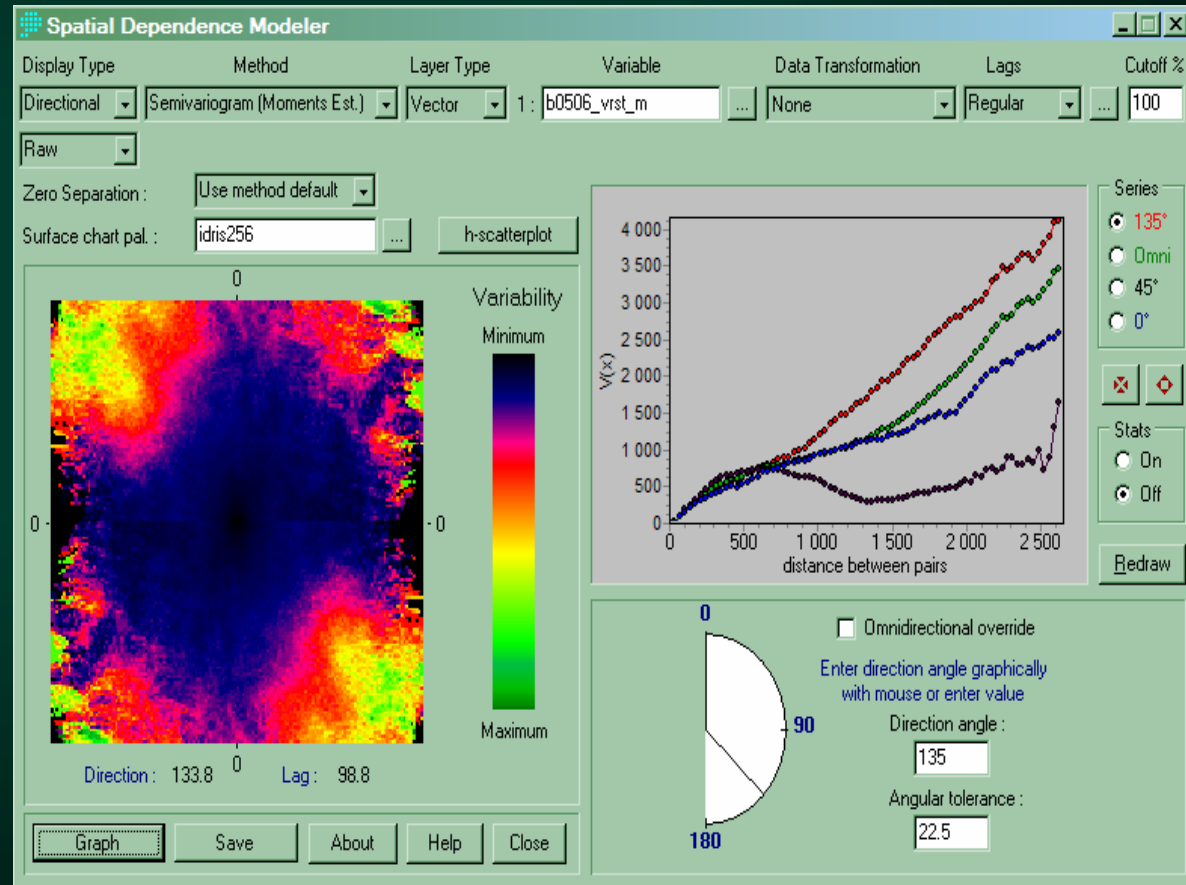
Geostatistické nástroje

Gstat v Idrisi Andes

Gstat (<http://www.gstat.org/>) je integrován do 3 grafických uživatelských rozhraní

Modul „**Spatial Dependence Modeler**“ – analýza složek prostorové variability dat

- experimentální stanovování šířky a počtu tříd (lag) pro výpočet variability jednotlivých párů
- prostorová variabilita se chová isotropně nebo anisotropně – všesměrové pole se rozděluje na směr minimální variability a směr maximální variability (při dané úhlové toleranci, např. 22,5°).
- vytvářejí se experimentální semivariogramy pro směry minimální a maximální variability (soubory s příponou var),



Gstat v Idrisi Andes

Modul „**Model Fitting**“ – stanovení a výpočet teoretického semivariogramu

- matematická funkce (11 variant), která nejlépe vystihuje zobrazený semi-variogram
- vizuálně co nejlépe stanovit její parametry (dosah, práh a zbytkový rozptyl).
- lze modifikovat i měřítko anisotropie a přidat do grafu dva další semivariogramy.
- systém poté automaticky zpřesní tyto parametry pomocí jedné ze tří metod (dvě váhové metody nejmenších čtverců – WLS a metoda maximální pravděpodobnosti – REML).

The screenshot shows the 'Model Fitting' dialog box in Idrisi Andes. The main window is titled 'Model Fitting'. It contains several sections:

- Sample variogram to fit model to (.var):** A dropdown menu is set to 'elev45max', and a 'deg.' field is set to '45'.
- Optional files (for display only):** Three empty text boxes for 'Sample variogram 2' and 'Sample variogram 3'.
- Method:** Radio buttons for 'WLS 1' (selected), 'WLS 2', and 'REML'.
- Change number of lags:** A checked box and a spinner set to '24'.
- Lag stats:** An unchecked box.
- Ranges (X), Sills (Y), Anisotropy Ratios:** A table with four structures:

Structure	Model	Range (X)	Sill (Y)	Anisotropy Ratio
Structure 1	Nugget		5.003170	
Structure 2	Spherical	509.744	713.329	1
Structure 3	Spherical	0	0	1
Structure 4	Spherical	0	0	1
- Iteration Limit:** A spinner set to '50'.
- Fit Limit:** A text box set to '1.0e-6'.
- Buttons:** 'Fit Model', 'View Log', 'Close', 'Save Model', 'Append to...', 'About', and 'Help'.

On the right side, there are two plots:

- Combined Structures:** A plot of $V(x)$ vs. 'distance between pairs' showing a red curve fitting the data points. The x-axis ranges from 0 to 600, and the y-axis ranges from 0 to 700.
- Independent Structures:** A plot of $V(x)$ vs. 'distance between pairs' showing a blue curve fitting the data points. The x-axis ranges from 0 to 800, and the y-axis ranges from 0 to 700.

Gstat v Idrisi Andes

Modul „Kriging and Simulation” – prostorová interpolace povrchu

- výběr z variant typu výpočtu povrchu (DMT)
- pro každý z teoretických semivariogramů vznikají až čtyři rastry. Dva obsahují hodnoty predikovaného povrchu (jeden pro souvislý povrch a jeden pro bodové hodnoty křížové validace) a zbývající dva obsahují hodnoty variancí (opět pro povrch a pro křížovou validaci).
- kromě těchto rastrových výstupů je možné vytvořit i textový soubor se statistikou vstupních dat a predikovaného povrchu.

Kriging and Simulation

Estimation and Statistical Options

Ordinary Kriging

Simple Kriging

Ordinary Kriging

Simple Cokriging

Ordinary Cokriging

Gaussian Simulation

Universal Kriging

Indicator Simulation

Local Linear Model Prediction

Kriging

Cross-validate on sample locations?

Block average variogram values

Size in x: Size in y:

Krige more than one stratum

How many?

Model Specification

Model source :

.prd File :

edit existing or new variograms

Input File(s)

Input Data File :

Data transformation :

Vector

Raster

Local neighborhood

Select options :

minimum number of sample points min. :

maximum number of sample points max. :

radius for sample selection radius :

force neighborhood selection

use variogram distance for neighborhood selection

set maximum observations per quadrant

Mask File (Optional if Input Data File is raster)

Output File(s) (Only first output filename required)

OK Save File About Help Cancel

ELEV2 – 45° směr minimální variability (maximální kontinuity) ORDINARY Kriging

corr(Obs, Pred): 0.9986 [using ordinary kriging]

	observed	predicted	pred.-obs.	pred.std.	zscore
minimum	260	260.3	-14	3.126	-1.2
1st q.	340	336.8	-0.8164	6.157	-0.1143
median	360	360.2	-0.005162	7.177	-0.0007764
3rd q.	380	381.6	0.6987	8.273	0.1067
maximum	420	420.8	13.44	16.08	1.686
n	2402	2402	2378	2402	2378
mean	357.8	357.8	-0.01592	7.288	0.001087
std.dev.	37.78	37.36	2.048	1.668	0.2498

ELEV3 – 135° směr maximální variability (minimální kontinuity) ORDINARY Kriging

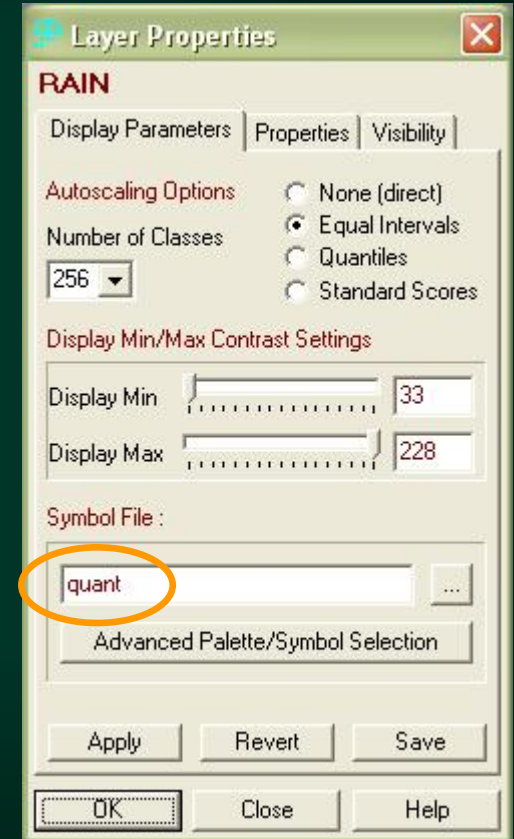
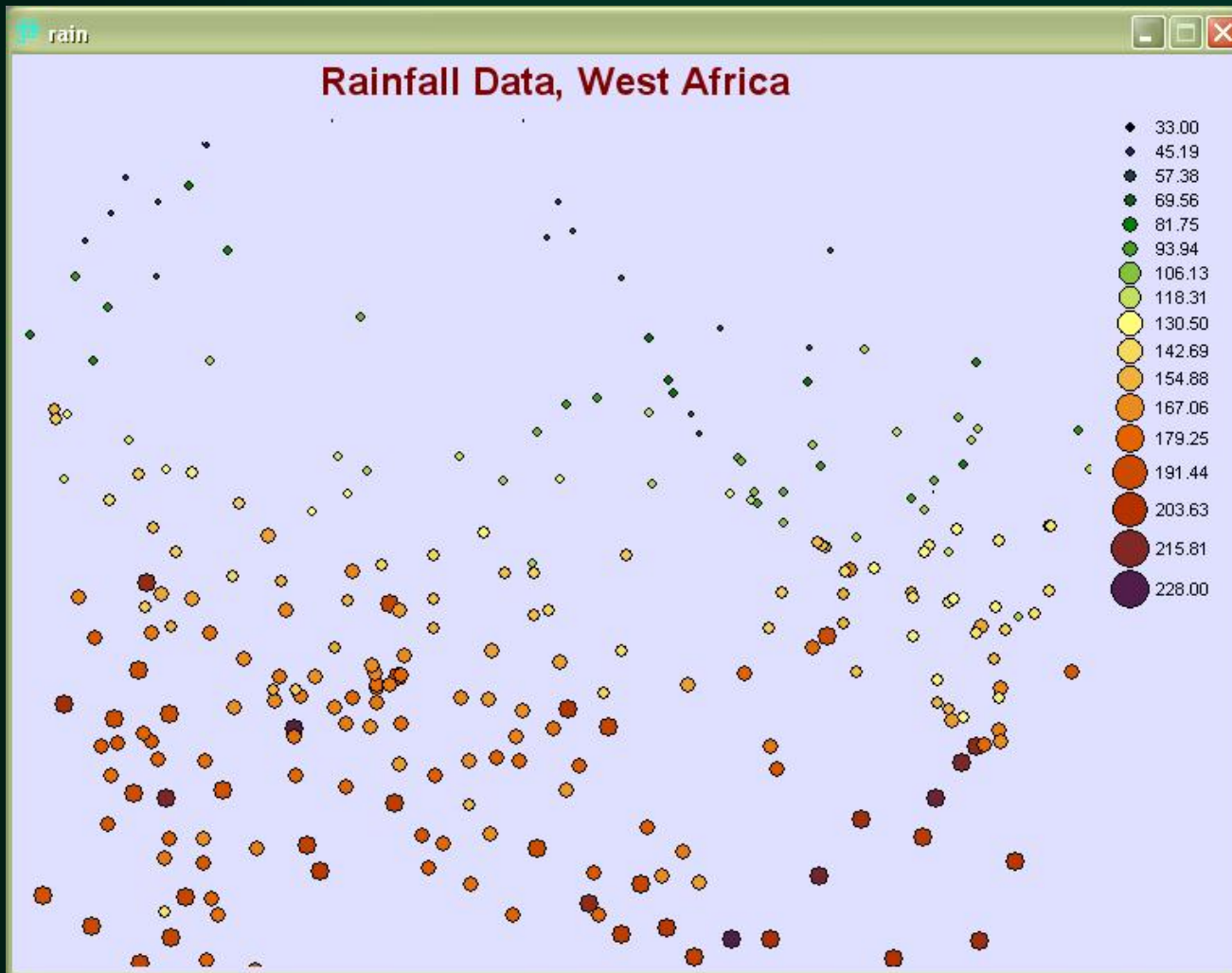
corr(Obs, Pred): 0.9978 [using ordinary kriging]

	observed	predicted	pred.-obs.	pred.std.	zscore
minimum	260	260.8	-11.2	5.695	-1.246
1st q.	340	335.9	-1.397	7.14	-0.178
median	360	360.3	-0.02638	7.707	-0.003044
3rd q.	380	382.2	1.213	8.323	0.1631
maximum	420	421.2	14.75	13.17	1.672
n	2402	2402	2402	2402	2402
mean	357.8	357.8	-0.04454	7.811	-0.002429
std.dev.	37.78	37.27	2.519	0.9451	0.3104

textový soubor se statistikou vstupních dat a predikovaného povrchu (příklad)

I - Spatial Dependence Modeler

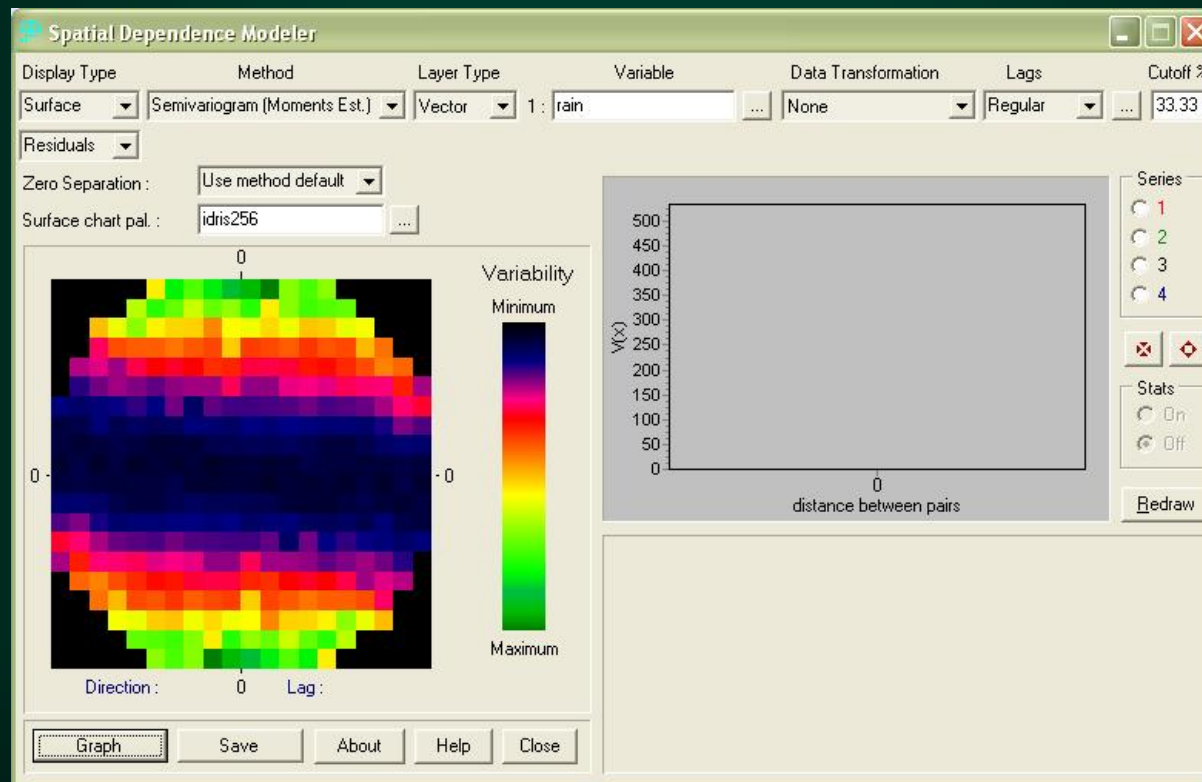
1) zobrazení dat



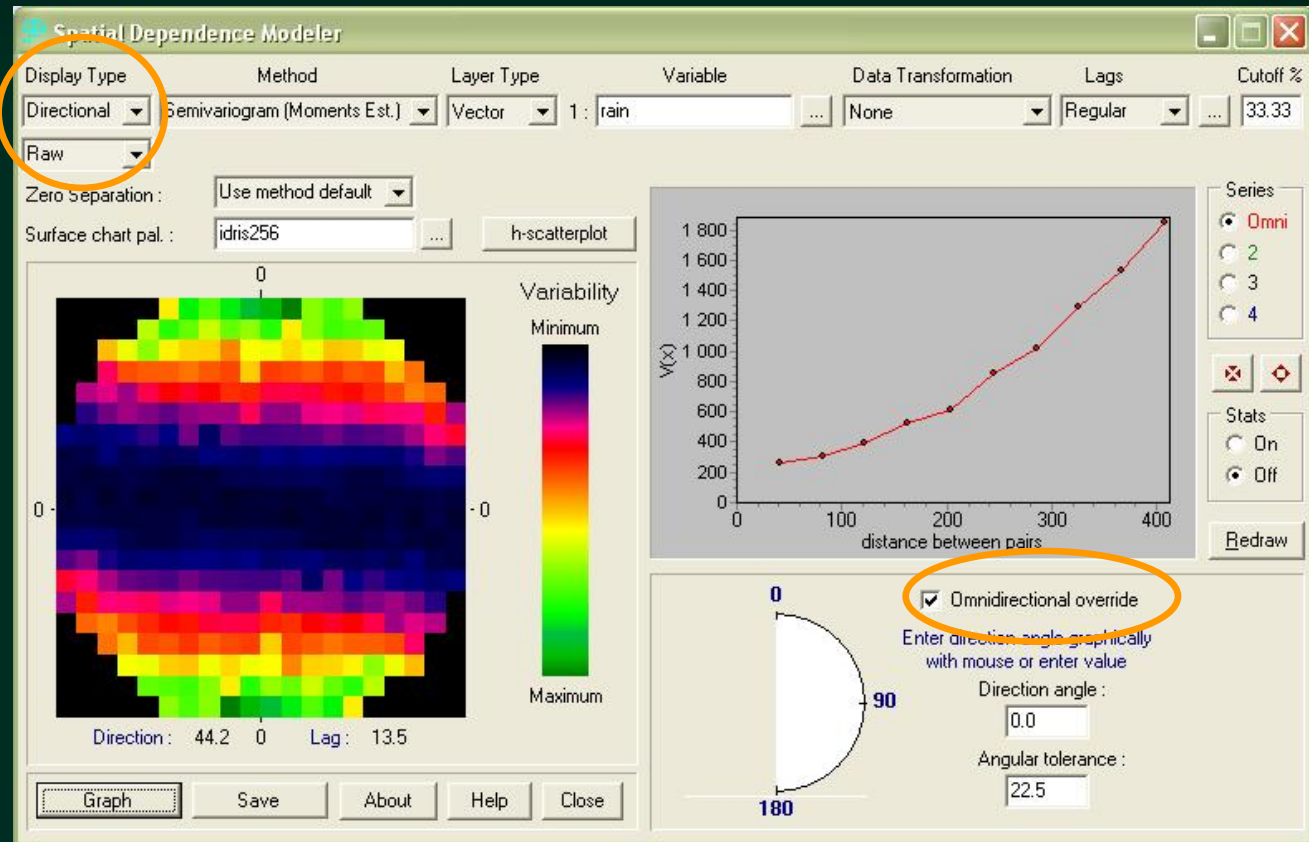
2) Spuštění *Spatial Dependence Modeler*

GIS Analysis → Surface → Geostatistics → Spatial Dependence Modeler

- zvolíme RAIN jako vstupní proměnnou („*Variable*“)
- zkontrolujeme nastavení „*Display type*“ na „*Surface*“
- necháme vytvořit „*Variogram surface graph*“ stiskem tlačítka „*Graph*“

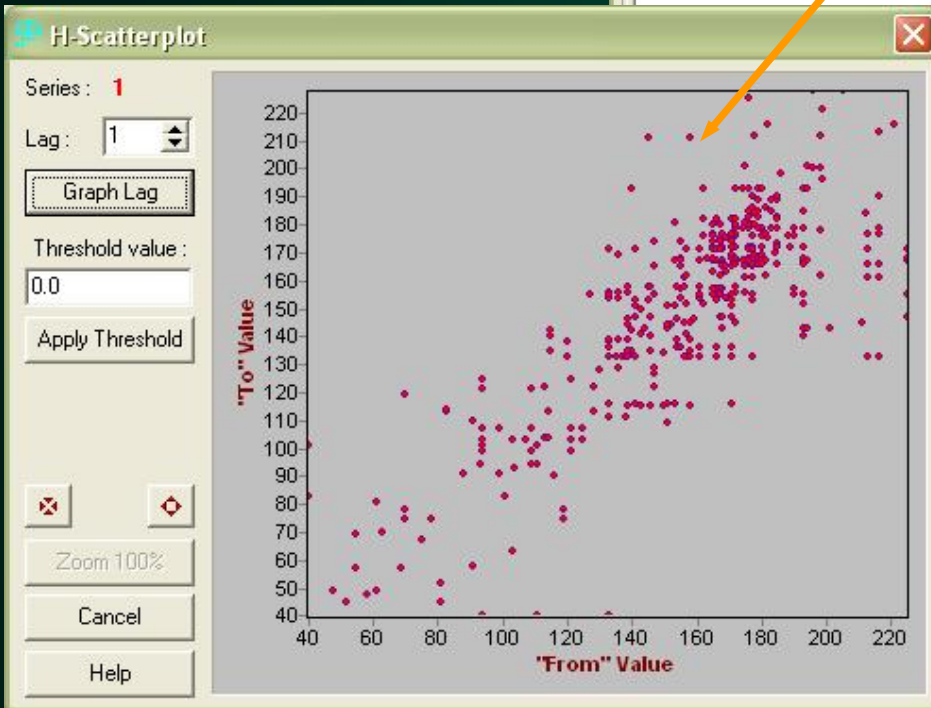
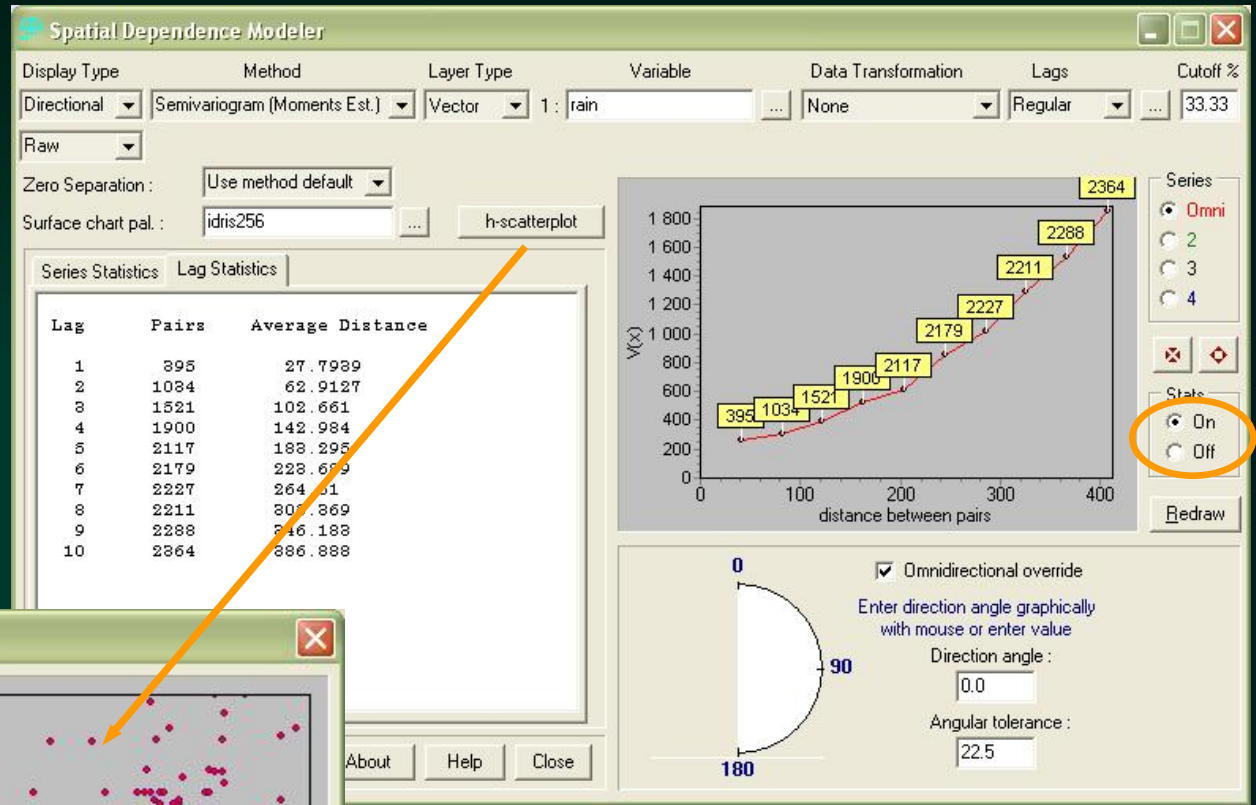


d) hledání prostorové závislosti ve srážkových datech



- na těchto datech je vidět jeden za základních axiomů geografie:

„Data“, která jsou si v prostoru blíže si budou podobnější než ta, která jsou od sebe dále.



Regular Intervals

Lag Specification

Automatic

Manual

Number of lags : 40

Lag width : 20

OK Cancel

Modeler

Method: Semivariogram (Moments Est.) | Layer Type: Vector | Variable: 1: rain | Data Transformation: None | Lags: Regular | Cutoff %: 100

Zero Separation: Use method default

Surface chart pal.: idris256

h-scatterplot

Variability

Minimum

Maximum

Direction: 114.6 0 Lag: 9.4

Graph Save About Help Close

Series

Omni

95°

3

4

Stats

On

Off

Redraw

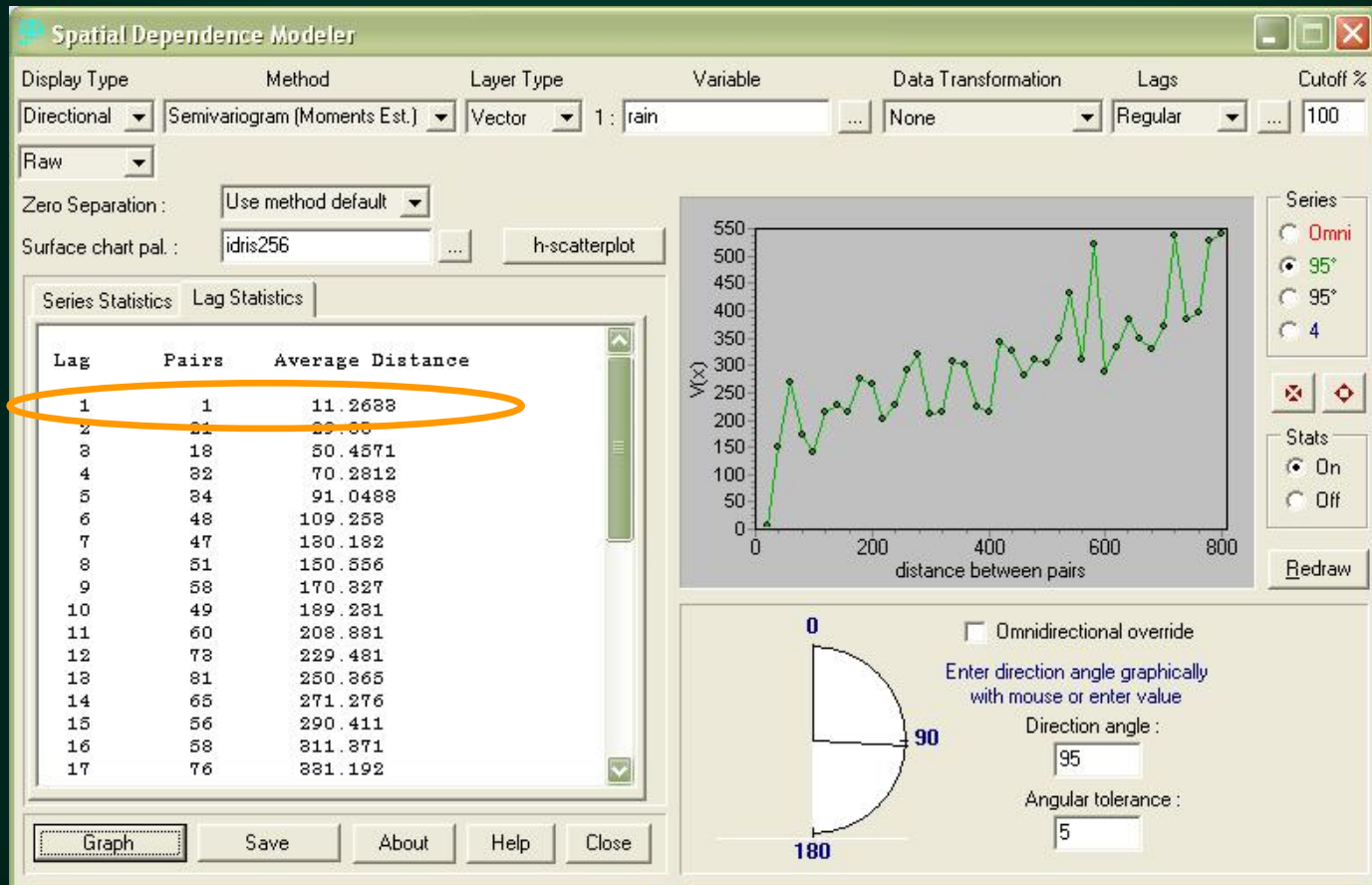
Omnidirectional override

Enter direction angle graphically with mouse or enter value

Direction angle : 95

Angular tolerance : 5

- první interval o šířce 20 km obsahuje pouze jeden datový pár, se vzájemnou vzdáleností 11.26 km → lze předpokládat, že prvních několik intervalů bude méně spolehlivých (málo datových párů), proto se budeme snažit, aby v každém intervalu bylo alespoň 30 párů (získání reprezentativního průměru)



Regular Intervals

Lag Specification

Automatic

Manual

Number of lags : 20

Lag width : 40

OK

Spatial Dependence Modeler

Display Type: Directional | Method: Semivariogram (Moments Est.) | Layer Type: Vector | Variable: 1: rain | Data Transformation: None | Lags: Regular | Cutoff %: 100

Raw

Zero Separation: Use method default

Surface chart pal.: idris256

h-scatterplot

Variability
Minimum
Maximum

Direction: 62.5 0 Lag: 10.0

Graph Save About Help Close

Series

Omni

95°

95°

5°

Stats

On

Off

Redraw

Omnidirectional override

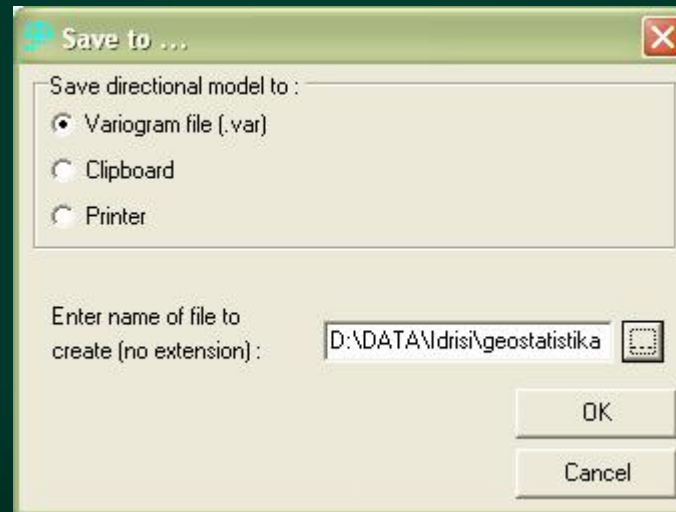
Enter direction angle graphically with mouse or enter value

Direction angle : 5

Angular tolerance : 5

- necháme si zobrazit graf pro směr 95°, 5° a Omnidirectional

- uložíme „směrové“ grafy jako experimentální semivariogramy:
 - i) variogram 95° → RAIN-major-95
 - ii) variogram 5° → RAIN-minor-5
 - iii) variogram omnidirectional → RAIN-omni



- nyní máme dostatek informací, abychom mohli odvodit prostorově souvislý model pro srážková data

II – Model Fitting

Modeling Zonal Anisotropy

- jako „*Sample Variogram*“ zvolíme RAIN-MAJOR-95W
- pokusíme proložit křivku body tak, aby je co nejlépe vystihovala

Model Fitting

Sample variogram to fit model to (.var): deg.

Optional files (for display only):

Sample variogram 2:

Sample variogram 3:

Method:

WLS 1

WLS 2

REML

Change number of lags

Lag stats

Actual Sills

1 0.3333

2 166.65

3 249.975

Iteration Limit:

Fit Limit:

Save Model

Append to...

About

Help

Angles: Angle 1: Angle 2: Angle 3:

Combined Structures

Independent Structures

Ranges (X) Sills (Y) Anisotropy Ratios

Nugget:

Structure 1:

Spherical:

Structure 2:

Exponential:

Structure 3:

Power:

Structure 4:

Fit Model View Log Close

III – Ordinary Kriging

a) cross validation

Kriging and Simulation

Estimation and Statistical Options
 Ordinary Kriging

Kriging Options
 Cross-validate on sample locations?
 Block average variogram values
 Size in x : Size in y :
 Krige more than one stratum
 How many ?

Model Specification
 Model source :
 .prd File :
 edit existing or new variograms

Specify model(s) to use :
 Var. 1
 Var. 2
 Covar.

Sph Exp Pow Lin Log
 Gau Cir Bes Pen Per

Input File(s)
 Input Data File :
 Data transformation : none
 Vector
 Raster

Local neighborhood
 Select options :
 minimum number of sample points min. :
 maximum number of sample points max. :
 radius for sample selection radius :
 force neighborhood selection
 use variogram distance for neighborhood selection
 set maximum observations per quadrant

Mask File (Optional if Input Data File is raster)

Output File(s) (Only first output filename required)
 Prediction File

Output File(s) (Only first output filename required)
 Variance File

OK

b) interpolace souvislého povrchu

Kriging and Simulation

Estimation and Statistical Options
 Ordinary Kriging

Kriging Options

Cross-validate on sample locations?

Block average variogram values
 Size in x: Size in y:

Krige more than one stratum
 How many?

Model Specification

Model source :
 .prd File : ...
 edit existing or new variograms

Specify model(s) to use :

Var. 1 ...
 Var. 2
 Covar.

Sph Exp Pow Lin Log
 Gau Cir Bes Pen Per

Input File(s)

Input Data File : ...
 Data transformation : none

Local neighborhood

Select options :

minimum number of sample points min. :

maximum number of sample points max. :

radius for sample selection radius :

force neighborhood selection

use variogram distance for neighborhood selection

set maximum observations per quadrant

Mask File (Optional if Input Data File is raster)
 ...

Output File(s) (Only first output filename required)
 ... Prediction File

Output File(s) (Only first output filename required)
 ... Variance File

OK

c) Porovnání interpolovaného povrchu se zdrojovými daty

- pomocí modulu OVERLAY

